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[625 .115]

Transition curves in both elevation and plan at the same time,

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Figs. 1 and 2, pp. 570 to 573.

When passing from the straight on to a circular curve it is usual to arrange for the centre line of the track to take the outline of a helix of the form :

$$\operatorname{tg} \alpha = \frac{h}{2L} \quad \ldots \ldots \ldots (1)$$

where h = the superelevation of the outer rail on the circular curve and L = the development of the projection of the helix on the horizontal plane. The cylinder upon which the helix winds itself has as its director one of the following curves [1]: cubic parabola (Nordlich transition curve); radiode with the abscissæ; lemniscate (radiode to Leber's chords); clotoïde (radiode to Leber's arcs).

We arrive at each of these director curves by observing the condition that in each point we satisfy the equation

$$Z = \frac{s}{g} \frac{V^2}{\rho} \quad \ldots \ldots \ldots (2)$$

and one of the following :

$$Z = \frac{h}{p} x; \quad Z = \frac{h}{p} c; \quad Z = \frac{h}{p} \sigma$$

in which :

Z = vertical ordinate through a point on the axis the abscissæ of which is x and the ordinate in the horizontal plane is y;

s = gauge of the line;

g = acceleration due to gravity;

V = speed of the vehicle under consideration;

ρ = radius of curvature of the director curves of the cylinder at a point of coordinates x, y;

c = chord from the beginning of the transition curve to the point of the director curve having as coordinates x, y;

σ = development of the director arc between the origin of the transition curve and the point of coordinates x, y.

(1) See Corini : *Lezioni di ferrovie*. For literature on this subject this work should also be consulted.

In our recent paper : « *Il raccordo razionale fra successive livellette* (1) » (The rational connection between two adjacent gradients) we demonstrated that when passing from one gradient to another, in order to annul completely or almost so, abnormal movements of the rolling stock, it was necessary to insert a transition curve on the vertical plane, defined when the line is on the straight, by the parabola :

$$Z = \frac{x^2}{2\Delta} \quad \ldots\ldots\ldots \quad (3)$$

and the transition should be given a development such that the x, of the end point, in relation to the initial point $x = 0$, is given by :

$$x_1 = 2\pi V \sqrt{\frac{I}{g}} \quad \ldots\ldots \quad (4)$$

where $I = \dfrac{Q}{2\Sigma \frac{1}{i_n}}$, Q being the spring-borne weight, and i_n being the flexibility of the springs. If the change of gradient should be on a curve, the formula (3) becomes :

$$Z = \frac{\sigma^2}{2\Delta} \quad \ldots\ldots\ldots \quad (5)$$

and the expression (4) then becomes :

$$\sigma_1 = 2\pi V \sqrt{\frac{I}{g}} \quad \ldots\ldots \quad (6)$$

The object of the present note is to determine what is the director curve of the transition curve that should be adopted instead of those mentioned above when at the same time a vertical transition curve is used, that is to say when the conditions expressed by the formulas (2) and (5) have to be satisfied simultaneously.

By substituting in (2) for Z its value given by (5) we get :

$$\frac{\sigma^2}{2\Delta} = \frac{s}{g}\frac{V^2}{\rho} \quad \ldots\ldots \quad (7)$$

from which we obtain :

$$\sigma^2\rho = H \quad \ldots\ldots\ldots \quad (8)$$

by using :

$$H = 2\frac{s}{g}V^2\Delta \quad \ldots\ldots\ldots \quad (9)$$

The expression (8) defines in the variables σ and ρ the required curve, the director of the cylinder of the transition curve.

If we designate by φ the angle that the tangent to the curve (9) at a point σ makes with the axis of abscissæ, coinciding with the tangent to the initial point of the transition curve, we get :

$$\frac{d\sigma}{d\varphi} = \rho \quad \ldots\ldots\ldots \quad (10)$$

By substituting this value of ρ in the formula (8) we obtain the equation :

$$\sigma^2 d\sigma = H d\varphi \quad \ldots\ldots \quad (11)$$

which when integrated gives :

$$\sigma^3 = 3H\varphi \quad \ldots\ldots \quad (12)$$

Taking $S = \dfrac{\sigma}{\sqrt[3]{3H}}$ the formula (12) becomes :

$$S^3 = \varphi \quad \ldots\ldots\ldots \quad (13)$$

Let us now calculate the parametric equations of the formula (12) with reference to the axis x of the abscissæ indicated above and to the axis y at right angles to x at the point of origin.

We have :

$$dx = \cos\varphi d\sigma; \quad dy = \sin\varphi d\sigma \quad . \quad (14)$$

Taking :

$$X = \frac{x}{\sqrt[3]{3H}}, \quad Y = \frac{y}{\sqrt[3]{3H}} \quad . \ . \quad (15)$$

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(1) *Il Politecnico*, 1928, No. 5.

and replacing φ by its value given by (13) we derive from formula (14):

$$\left.\begin{aligned} X &= \int_0^S \cos(S^3) \cdot dS \\ Y &= \int_0^S \sin(S^3) \cdot dS \end{aligned}\right\} \quad . \; . \quad (16)$$

The integrals in (16) are particular cases of the « cosine and sine potentials » functions developed by Leber [1] the general form of which is the following:

$$C\,S^n) = \int_0^S \cos(S^n)\, dS;$$

$$S\,(S^n) = \int_0^S \sin(S^n)\, dS.$$

The values of these functions can be calculated by means of convergent series of the powers of S, series given by Leber. In the case we are dealing with, that is to say when tracing out railway transition curves, the value of

$$S = \frac{\sigma}{\sqrt[3]{3H}}$$

is always very small: consequently satisfactory values of X and of Y can be obtained by developing in series the cosine and the sine and effecting ter integration of the series; we find in this way:

$$\left.\begin{aligned} X &= \int_0^S \left(1 - \frac{1}{2!}S^6 + \frac{1}{4!}S^{12} - \ldots\ldots\right) dS \\ Y &= \int_0^S \left(S^3 - \frac{1}{3!}S^9 + \frac{1}{5!}S^{15} - \ldots\ldots\right) dS \end{aligned}\right\} \quad \ldots\ldots \quad (17)$$

or

$$\left.\begin{aligned} X &= S\left(1 - \frac{1}{2!}\frac{S^6}{7} + \frac{1}{4!}\frac{S^{12}}{13} - \ldots\ldots\right) \\ Y &= \frac{S^4}{4}\left(1 - \frac{4}{3!}\frac{S^6}{10} + \frac{4}{5!}\frac{S^{12}}{16} - \ldots\ldots\right) \end{aligned}\right\} \quad \ldots\ldots \quad (18)$$

and finally

$$\left.\begin{aligned} x &= \sigma\left(1 - \frac{1}{12\sigma}\frac{\sigma^6}{H^2} + \ldots\ldots\right) \\ y &= \frac{\sigma^4}{12H}\left(1 - \frac{4}{540}\frac{\sigma^6}{H^2} + \ldots\ldots\right) \end{aligned}\right\} \quad \ldots\ldots \quad (19)$$

By taking into consideration only the first terms of the two series, we have:

$$\left.\begin{aligned} x &= \sigma \\ y &= \frac{\sigma^4}{12H} \end{aligned}\right\} \quad \ldots\ldots \quad (20)$$

Eliminating σ in the two expressions of (20) we get:

$$y = \frac{x^4}{12H} \quad \ldots\ldots \quad (21)$$

[1] Max Edler von Leber: *Raccordements*. (Transition curves.) — Paris.

The formulas (19) can be written as functions of φ by means of the expressions (12); we get:

$$\left.\begin{aligned} x &= \left(3H\varphi\right)^{\frac{1}{3}}\left(1 - \frac{9}{126}\varphi^2 + \ldots\right) \\ y &= \frac{1}{4}\left(3H^{\frac{1}{3}}\varphi^{\frac{4}{3}}\right)\left(1 - \frac{36}{540}\varphi^2 + \ldots\right) \end{aligned}\right\} \quad (22)$$

Lay out of the transition curve. — Let us first of all ascertain the values to be used for the coefficients Δ and p. In order to do this, let us start by an approximation on the hypothesis that we neglect the

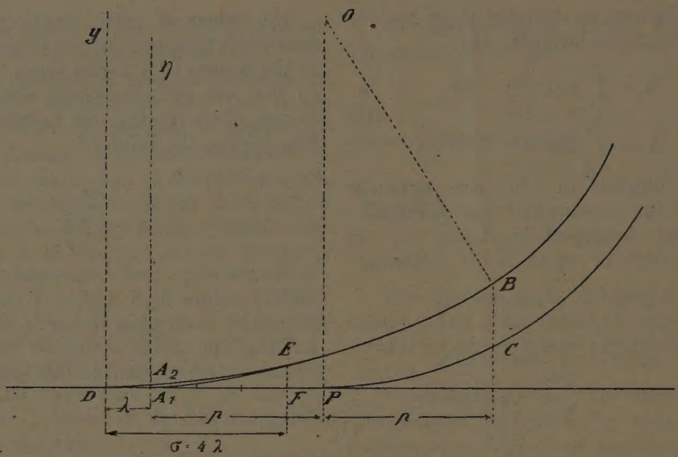

Fig. 1.

transition curve on the vertical plane: the transition curve in plan is calculated by means of the usual methods. Let P be the original tangent point, O the centre of the circle, A_1B will be the transition (cubic parabola, clotoidal transition, etc.). BC will represent the reduction of the radius or the displacement of the circle. Let us now proceed to deal with the transition curve on the vertical plane. It will develop over a length σ_1 of the transition curve in plan given by:

$$\sigma_1 = 2\pi V \sqrt{\frac{I}{g}} \quad \ldots\ldots (23)$$

The point of origin of the new transition curve will be found at A_1. The ordinate $E_1 F_1$ is given by:

$$y_1 = \frac{1}{3H} \sigma_1^4 \left(\frac{1}{4} - \frac{1}{540} \frac{\sigma_1^6}{H^2}\right) \ldots (24)$$

or by:

$$y_1 = \frac{g}{24_s \Delta V^2} x^2 \quad \ldots\ldots (24')$$

if we start from the expression (21), with the help of (9): whilst the abscissæ $D_1 F_1$ will be:

$$x_1 = \sigma_1 \left(1 - \frac{1}{126} \frac{\sigma_1^2}{H^2}\right) \quad \ldots (25)$$

or we can take $x_1 = \sigma_1$, as a wider approximation.

The transition curve AB, referred to the axes $\eta = A_1 A_2$, $\xi = A_1 P$, is given by:

$$\eta = \frac{\xi^3}{12 p R} \quad \ldots\ldots (26)$$

or by other known expressions if one of the radiodes be used.

Let us stop at formula (26). The method we give for this case can be used for every other type of transition curve.

The ordinate of the point E, considered as belonging to the curve (26) is given by:

$$\eta_1 = \frac{(x_1 - \lambda)^3}{12 p R} \quad \ldots (27)$$

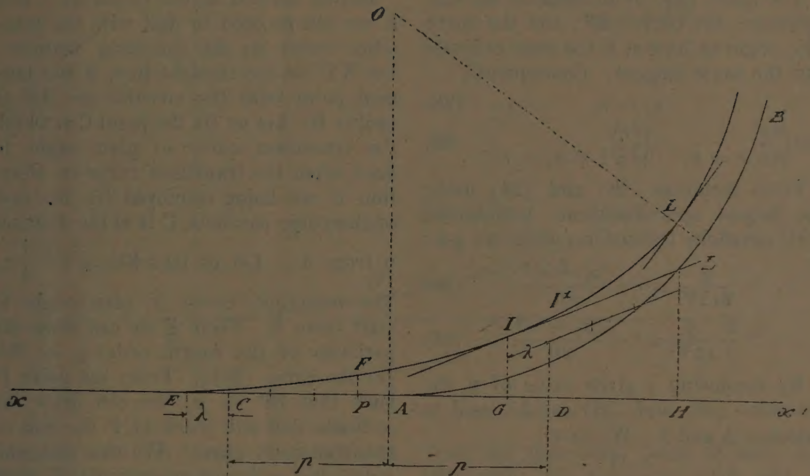

Fig. 2, *a*.

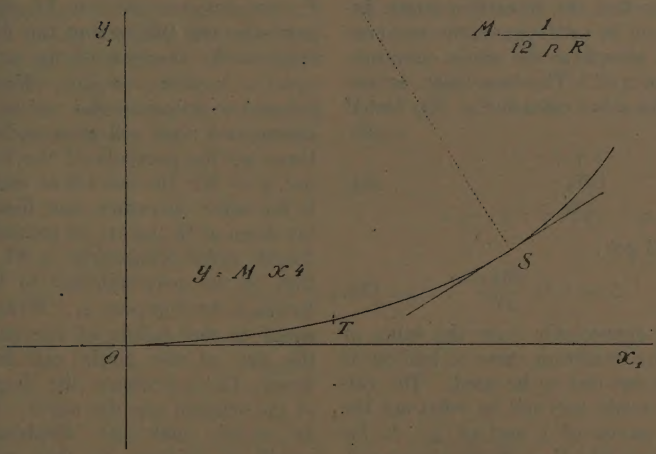

Fig. 2, *b*.

The curve (24) or to simplify the calculations, the curve (24′) and the curve (26) ought to have at E the same ordinate and the same tangent. Consequently :

$$y_1 = \eta_1 \quad \ldots\ldots (28)$$

$$\text{and} \left(\frac{dy}{dx}\right)_{x = x_1} = \left(\frac{d\eta}{d\xi}\right)_{\xi = x_1 - \lambda} \quad \ldots (29)$$

From formulas (28) and (29) using the largest approximations permissible with parabolic transition curves we get :

$$\frac{g}{2s\Delta V^2}\sigma_1{}^4 = \frac{(\sigma_1 - \lambda)^3}{pR} \quad \ldots (30)$$

$$\frac{2}{3}\frac{g}{s\Delta V^2}\sigma_1{}^3 = \frac{(\sigma_1 - \lambda)^2}{pR} \quad \ldots (31)$$

By supposing a given value of p, the formulas (30) and (31) can be used to calculate Δ and λ. We have :

$$\lambda = \frac{1}{4}\sigma_1 \quad \ldots\ldots (32)$$

$$\Delta = 1.185\frac{pRg\sigma_1}{sV^2} \quad \ldots (33)$$

In order that the transition curve described may be satisfactory, the two curves must also have the same curvature at the point E. This condition is not met by the value cited for Δ. In fact if we take :

$$\left(\frac{1}{\frac{d^2y}{dx^2}}\right)_{x = \sigma_1} = \left(\frac{1}{\frac{d^2\eta}{d\xi^2}}\right)_{\xi = x_1 - \lambda} \quad \ldots (34)$$

we should get :

$$\Delta = 1.33\frac{pRg\sigma_1}{sV^2} \quad \ldots (35)$$

differing appreciably from the value of (33). The transition curve so laid out is therefore not one to be used. The calculations made only tell us what are the suitable values of λ and of Δ. It for example, we take V = 33 m. per second, $2\ p = 60$ m., R = 1 000 m., $s = 1.445$, $g = 9.81$ m. per sec², $\sigma_1 = 31$ m., we obtain : $\lambda = 7.75$, $\Delta = 7\,500$ m.

Having arrived at the values of λ and Δ we can proceed to deal with the transition curve in the following manner : Let XX′ be the straight line, A the tangent point with the circular arc AB of radius R. Let us fix the point C at which the transition curve in plan ought to start when the transition curve in elevation is not being employed (in the case of the cubic parabola, C is at the distance p from A). Let us take EC $= \lambda = \frac{1}{4}\sigma_1$.

The transition curve in plan ought to start from E. From E we can draw the parabola of the fourth order $y = Mx^4$ [or the curve (23)]. From the point P, such that EP $= \sigma_1$, we can draw the ordinate that will mark af F the end of the transition curve. We can then calculate the radius of curvature at F, after which we will look for the point on the curve $y = Nx^3$, plotted separately, which has the same curvature. Starting from F, we can set off on FI the cubic parabola arc QR having the difference between the abscissæ of the end points equal to $2p - \sigma_1 \cos \varphi_m$. We can then proceed to calculate the radius of curvature at I : we will then endeavour to locate on the parabola of the fourth order, $y = Mx^4$ the point S at which there is the same curvature, and then we can lay down at IL the arc of parabola of the fourth order symmetric to ST in relation to the perpendicular to the curve having a development σ_1. With a radius equal to the radius of curvature at L the arc of the circle can be drawn down; LL′ represents the displacement of the original circular curve. It should be noted that the displacement is small in relation to that which occurs in the other transitions, in this sense that IL becomes an « inverted » transition, that is to say one having in-

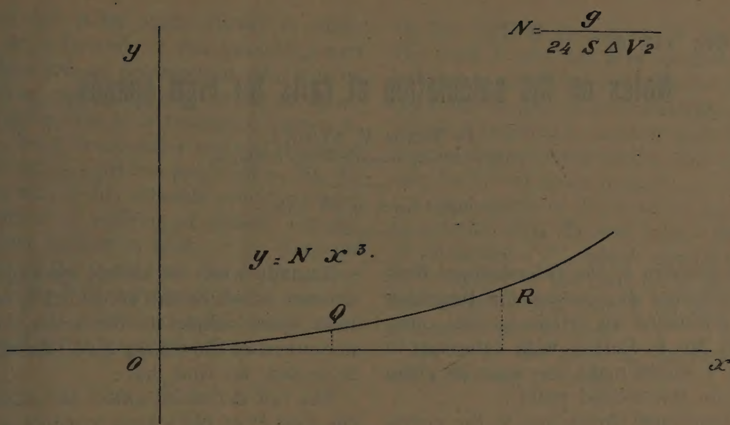

Fig. 2, c.

creasing radii. It would be possible to have nil displacement if it were not necessary to satisfy the condition that the transition of the fourth order ought to be developed over a length σ_1.

The graphical solution we have just described makes possible the easy compilation of tables by means of which the curve can be laid out quickly.

It is to be noted that the analytical solution of the layout does not present, from the theoretical point of view, any difficulty. We have not dealt with it because it involves very complicated calculations. It should be noted that if we wish to adopt in place of the parabola of the fourth order the curve (23) and in place of the parabola of the third order one of the other known transition curves, the method of laying out the curve will still be the one we have given above.

[625 .143. (01]

Notes on the calculation of rails for high speeds,

By Victor V. STOÏKA,
CHIEF ENGINEER, RUMANIAN STATE RAILWAYS.

Figs. 1 and 2, pp. 574 to 576.

The *Bulletin of the International Railway Congress Association* for December 1928, published an article on this question by Mr. F. Corini, with reference to which, I would make the remarks given below on the second point :

« Centrifugal force due to the curvature of the rails on the vertical plane. »

Many engineers allow, to take into account the dynamic effect of the rolling load on the rails, a coefficient which may be called the *dynamic coefficient* and which includes « the centrifugal force due to the curvature of the rails in the vertical plane ». In our opinion, and as a result of observations we have made on the Rumanian Railways, this theory is in complete contradiction with what actually takes place on the track : this theory ought to be abandoned and replaced by another more closely in agreement with the facts.

Actually when we closely examine the manner in which the deformation of the rails when subject to the action of the movement of the rolling load (the wheel) is caused, we find that :

The rail deformed under the action of the load P of the wheels remains so deformed during the whole time the load P moves along it, so that no curvilinear movement in the vertical plane occurs which might set up any centrifugal force. The curvature of the rails more or less conserves the same form and deflection under the load P during its whole travel and there is no reason why any centrifugal force should develop.

In actual fact, the phenomenon occurs almost in the same way as that which takes place when cloth is ironed (see fig. 1), but instead of the single effect of friction between the material and the iron, there occurs partly a frictional ac-

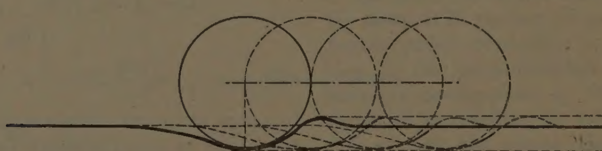

Fig. 1.

tion and a rolling action as if the rail were subjected to a sort of rolling in which the rail remains stationary, and the cylinder of the rolling mill passes over it at a more or less high speed.

This gets back moreover, if we refer to what we have stated above, to the formula for track resistance: because in the event of a permanent deformation of the rail, which always follows the load of the

wheel this latter ought always to climb the slope formed by the ascending part of the curve of deformation (the line of yielding) which in the horizontal direction gives rise to a resistance known as the « track resistance » and has the same form as the equation proposed by Mr. Timoshenko in his valuable analytical work « Method of analysis of statical and dynamical stresses in rails » [1]. That the effect of the speed v on the bending due to a force P in movement is the same as that of an additional axial compressive force H given by an equation :

$$H = \frac{q \cdot v^2}{g}$$

I. — *As horizontal and axial force acting on the rail, we have therefore a force equal to the reaction of the track resistance, that is to say equal and in opposite direction to the track resistance.*

II. — *As vertical force* other than the vertical loads due to the movement of the locomotive and its different parts, the principal force acting on the rails is the load P of the wheel under consideration.

When the load P is moving horizontally the time t it takes to act with full intensity on the mass of the rail or of the line must be taken into account.

If the time t during which the wheel or the load P is in contact with the rail in a given section S is sufficiently long for the load P to produce or develop the full reaction R of the rail, making the dynamic equilibrium of the moving force P we then get the maximum depression of the rail or of the track in the section S.

If the time t is shorter, the depression of the rail is less and the force P will not be able to act with its full power on the vertical resistance of the track. The load P will not give its full power but only a part more or less great according to the length of time available during which it remains in contact with the rail and in these circumstances, the rail will only be forced down in part.

Consequently in this case we must take in account what Maxwell calls « the time of relaxation » [1], which can be applied in principal to the rails or to the track and calculate this time T for each track and each train of loads.

Let V *be the speed of relaxation* the value l/t, that is to say :

$$V_r = l/t$$

for two sections of the rail at a distance l apart. This means that for these two sections s_1 and s_2 which are a distance l apart, it requires a time interval t for the load P passing over this distance (at a speed $V_r = 1/T$) for these sections to come fully into action with the full resistance they can develop to absorb the whole of the work due to the load P which moves over the rail or the bar.

Let us suppose that to get the full action of the sections s_1 and s_2 it required the same time t as for the release; this is perhaps not absolutely correct, but it is very probable that these two periods are sufficiently close to one another for the conditions of application to be the same. We shall therefore find the time of relaxation indicated above, *by measuring the changes of level of the rail or of the track corresponding to the different speeds of the same load* P, which moves over them : the speed which corresponds to the depression or to the maximum de-

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(1) See *Proceedings* of the 2nd International Congress of Applied Mechanics, Zurich, p. 407.

(1) 1. Cl. Maxwell *Encycl Brit*, 9th Edition, Vol. VII, page 798 « Scientific Papers 2 », Cambridge 1890, p. 26.

flection is the maximum speed of relaxation or the *critical speed* V_c which also gives the time T of relaxation.

When this critical speed V_c is passed the influence of the load P on the rail gradually diminishes, so that at infinite speed the effect is nil, the moving P becoming tangent to the track.

The maximum depression obtained in this way will give in comparison with the static depression of the track under the same loading diagram, the *dynamic coefficient* K.

The dynamic coefficient K by which should be multiplied the static moment that the load P produces on the rail will then be a function of the speed V of this load.

$$K = f(v)$$

which correspond to the curve shown in the diagram (fig. 2).

It is of course understood that in the function $f(v)$ other terms enter and are included in the formulas for the calculations of rails, the most important being the inertia of the track and of the rail.

By the practical method given above, of measuring the changes of level of the track under the load P at different and increasing speeds, or of the diagram of loads P_i we get a really accurate result,

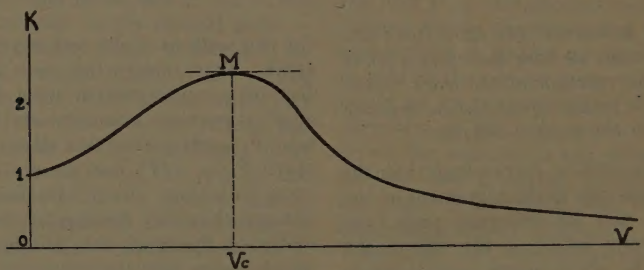

Fig. 2.

which agrees with the diagrams of the loadings P and with the conditions of the track : theoretically, it will be impossible to get these results in any other way more exactly.

If we consider a diagram of loads P_i such as a train, the influence of the different loads becomes superimposed for the speed which exceeds the critical, and we get a general compression of the whole track on the section run over by the train.

This gives rises to a pressure and therefore a general settling over the whole extent of the track subjected to the train in movement and the phenomenon of bending disappears totally, or nearly so.

The bending of the rail under the load P disappearing completely for a train or rake of stock which attains or exceeds the critical speed, with greater reason we cannot suggest in this case any effect due to centrifugal force, the subject of this note.

On the Roumanian Railways, for a track in a good state of repair with type 40 rails, this critical speed « V_c » corresponds to an average maximum of about 80 km. (50 miles) an hour.

This speed also depends upon the temperature, the state of humidity or dryness, etc. For each part of the line the critical speed corresponding to the most

unfavourable conditions must be ascertained, which speed will be of use in determining the best method of working for the portion of line in question. By making a suitable adjustment between the diagram of loads P (for example the heaviest train), and the highest running speed allowed over the section of line in question, it is possible to arrive at an *equilibrium of maximum fatigue* allowable on this part of the line and which must not be exceeded.

As for the other vertical forces : loads transmitted through the rods, parasitic and inertia movements of the locomotive, etc., they do not come within the scope of this article. All these different forces ought to be added to the static vertical load P and resultant moment multiplied by the dynamic coefficient which has been obtained from the tests mentioned above.

Bucarest, December 1928.

[624 .62 (.73)]

The projected Kill van Kull steel Arch Bridge between New-Jersey and Staten Island, New-York City. [1]

Figs. 1 and 2, p. 579.

The great arch bridge, the Hellgate bridge [2] constructed during the war has already been described in the Bulletin. This structure at that time held the world's record for the greatest span of any arch bridge. It will soon be exceeded by the Sydney bridge and ultimately by the Kill van Kull bridge of the same type which, with a span of 1675 feet will be 25 feet greater then the Sydney bridge and 680 feet greater than the Hellgate.

In comparison with the Hellgate bridge (995 feet span) the loads at the skewbacks will be practically the same. The reason for this lies, in spite of the great difference in span, in the much greater loading of the Hellgate bridge (4 lines of railway with Cooper E 60 train) whereas the Kill van Kull bridge will carry only the ordinary loading of a roadway and two fast railway lines. The uniform live load will be 5 600 lb. per foot for the Kill van Kull bridge (24 000 lb. for the Hellgate). The corresponding figures will be 29 400 000, and thirty million 544 000 lb. on the skewbacks, and 34 324 000 and 37 770 000 lb. for the weight of steel; 1 1/2 and 2 inches for the thickest plates used.

The design of the Kill van Kull bridge was based on 6 highway lanes and was strong enough to carry 4 such lanes with 2 fast railway lines. At first room for only four lines of traffic will be provided. Careful comparison was made between the three types of construction suitable for this span: Arch; Suspension; Cantilever.

The last named was at once abandoned as being too costly and also for æsthetic reasons.

The comparison was then worked out completely as between the arch and the suspension types, and showed that the former would cost about 18 000 000 dollars and the latter 19 600 000, or a saving of about 1 600 000 dollars in favour of the arch bridge.

In addition very great importance was attached to a high degree of rigidity in view of the ultimate laying of two fast railway lines in the near future.

The calculation of the deflections showed that in the case of the suspension type of bridge they would be 7 1/2 times greater than in the case of the arch type.

In short, the arch type bridge was chosen because of its lower cost, its greater rigidity, and its pleasing appearance.

The main arch trusses (hinged at the skewbacks) of the bridge are in trellis, the lower boom having a span of 1 652 feet between the hinge pins.

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(1) From *Engineering News-Record* of 13 December 1928.

(2) See *Bulletin of the Railway Congress*, January 1927, p. 5.

Fig. 1.

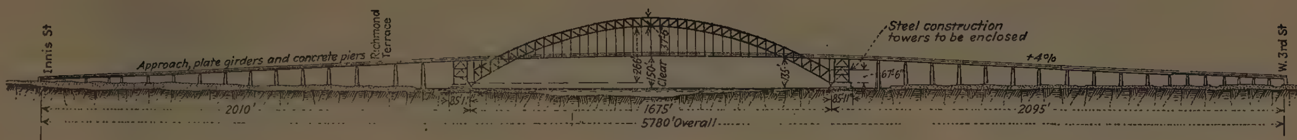

Fig. 2.

Figs. 1 and 2. — Elevation of the Kill van Kull bridge.

The curvature of this boom is 274 feet. The depth at the centre between the chords of the arch trusses is 37 1/2 feet.

The panel point curves of both chords are true parabolas. The arch trusses are 74 feet apart between centres giving a clear roadway width of 65 feet.

The *bottom chord* is the main arch element. It measures 5 ft. 5 in. by 6 ft. 10 in. overall. It is a nickel steel double box section.

The maximum section in the first panel is 983 square inches, the maximum stress being 27 923 000 lb.

The upper chord with the web system acts primarily as bracing for the lower boom. The upper chord is made of silicon steel, the details of the web system are of carbon steel. The supports consist of two shoes in cast steel with an intermediate hinge pin 16 inches in diameter.

The more important stresses allowed for the different qualities of steel are the following:

Carbon steel, 20 000 lb. per square inch.

Silicon steel, 27 000 lb. per square inch.

Nickel steel, 33 000 lb. per square inch.

The bridge is being built for the Port of New-York Authority. The design and construction are being carried out under Mr. O. H. Ammann, as Chief Engineer of Bridges.

R. D.

[628 .214]

The axle boxes in use on railway rolling stock considered from a technical point of view,

By L. FARON,

INSPECTOR OF THE EASTERN RAILWAY OF FRANCE.

Fig. 1, p. 585.

As a result of the constant growth of traffic and the increase in rolling stock, the question of improving the behaviour of axle boxes in service is one of real importance.

It should be pointed out that tests have been carried out without end in order to reduce the costs :

of manufacture,
of lubrication,
of fuel,
of labour in repairs,
etc.

But the question to which the railway companies devote most attention is *the reduction of the number of « hot boxes »*.

As every one knows, the heating of an axle box causes considerable disturbance in the working, especially if the journal breaks, the consequences of which may be very serious such as a derailment, etc.

Apart from the vehicle having to be taken out of traffic, and the interference with the working so caused, the costs of transhipping, lifting, replacement of costly details, such as the bearings, wheels and axles, etc., must be taken into account.

For these reasons, everything possible should be done to avoid defects of this kind.

With this object in view, the railway companies prepare statistics which reveal as it were almost automatically, the steps required to be taken to improve the running of the stock.

Many factors, however, have to be considered : the design of the axle boxes; the method of oiling; the kind of lubricant; the composition of the bearings; degree of finish of the journals, etc.

In the following article, we shall only deal with the construction and fitting up of axle boxes, and their lubrication, the whole of the other factors having been, practically speaking, defined and settled by the Railway Congresses.

Usual patterns of boxes.

The divided type of box has the disadvantage, that it becomes loose through vibration, and this means loss of oil and even heating when the bottom half drops so far that the lubricator pad only acts on part of the journal.

In new stock, therefore, single piece boxes ought to be used; such boxes are also easier to look after.

As a rule, the oil is supplied to the boxes through an oiling hole in the top or the base of the box, or by a combination thereof to get top and bottom oiling.

The dust shield placed at the back of the box is intended to cover up the play between the axle and the edges of the corresponding opening in the box and to prevent loss of oil when running, and the entrance of water and dirt.

This fitting has, therefore, a role of great importance, *which it often only imperfectly fills*.

So far, only a few railways have seriously investigated these defects.

Dust shields with complicated metal springs have been designed and have given satisfaction for a time, although they wore and rusted very quickly.

In the case of some tender axle boxes, a leather washer pressed into a groove by a plate secured to the box by bolts unfortunately very difficult to get at has been used.

This lack of tightness at the back of the box is generally to be found and results in dirtiness and in noticeable losses of oil, which adheres to the wheels and axle guards.

With regard to the water which gets into the box, certain companies have issued instructions that it is to be drawn off by a syringe through the lower oil hole when this can be done.

It is in fact essential to prevent water from getting into the boxes, because it may interfere with the capillary action of the streamers : tests carried out on this subject have shown that so long as there is any oil in the box it will be fed to the pad by the streamers, just as though there was no water in the box : but if allowed to accumulate in the bottom of the box the water drives out the oil and in the long run can upset the lubrication of the journal by displacing the whole of the oil.

Grease axleboxes.
(*Patented*).

In order to avoid the loss of oil when end or side tipping, grease axleboxes have been designed and have given some satisfaction, the grease only escaping from the back of the box under very high atmospheric temperatures, or when the vehicle is near any hot material, such as molten slag, hot blooms, etc.: as occurs in all kinds of service. In addition, water and dust can get into the box through the back and form an abrasive which may damage the axle unless the grease is changed frequently. The cost of the grease is however much higher than that of the mineral oils as now used, so that its general use is not to be thought of.

Waste packed boxes.

The American « packing » consists of wool and cotton waste, sometimes mixed with a little hair and tightly packed under the journal.

The following are a few « packing » mixtures :

50 % wool, 25 % cotton, 25 % hair;
90 % wool, 10 % hair;
50 % wool, 50 % hair.

Some companies use a mixture of wool, hair and asbestos, known as « perfect packing ».

Whatever its mixture, the « packing » should be previously soaked at least thirty hours in clean oil : then it should be pressed to get rid of all the surplus oil, after which it should be very tightly packed in the bottom of the box, so as to bear with as uniform pressure as possible, the full length of the journal.

This forms the simplest form of lubricator and generally speaking, the American companies who use the standardised method of packing with oily waste are not dissatisfied with it.

Unfortunately, as it is almost impossible to ascertain the level of the oil in the boxes, the greasers have a tendency to give too much oil, and this excess escapes through the back of the box when the vehicle is on a superelevated section.

The disadvantage of « packing » is that is becomes dirty quickly, chiefly through dust getting in at the back, and consequently it has to be renewed every six months.

The waste packed boxes are frequently fitted with a spring front, so that they can be easily opened : it exposes them to misuse; four of the English railways have found that the inside parts, the oil, and the packing are stolen, causing serious annoyance in service. To overcome these defects, the covers are at the present time riveted, instead of being bolted.

Ball and roller bearing axleboxes.
(Patented).

Lubrication is assured by filling the inside of the box with grease.

The defects consist of small cavities, which develop on the surface of the balls, the rollers, the inner and the outer races. These boxes require extremely accurate workmanship, to within one hundredth of a millimetre. The coefficient of rolling resistance is of course lower than the coefficient of friction, but the improvement such boxes show, disappears as soon as the surfaces in contact alter in shape.

Rolling stock is sometimes so roughly used, not only in shunting yards, but even out on the line, that the use of these complicated and costly axleboxes (five to six times the price of the ordinary boxes) is not yet considered desirable.

Mechanica ly lubricated axleboxes.
(Patented).

This type of box was tried on a large scale sixty years ago (Dietz patent) but had to be abandoned because the oil escaped at the back at high speeds in spite of the oil retaining ring.

Various modifications of this system are in use in Europe and have the same drawback, which becomes particularly serious when the oil gets on to the face of the brake block, thereby reducing the braking effort, or when the rail is a conductor of electricity, or finally, when the oil is used up.

The oil is thrown off violently, by centrifugal force and sometimes is forced through the joint of the front cover.

As with the Dietz boxes, any sand present is taken up by the paddle or disc according to the design, and causes premature wear of the bearing and journal which latter shows a characteristic matt shade.

A recent improvement, however, consists in applying by means of a grease gun, a special lubricant which clings to the metal whilst at the same time covering over all foreign matter.

Unfortunately though, other defects which it is almost impossible to overcome, are to be found in these bulky, heavy, and complicated boxes.

In order to keep the oil in the box the bearing should be tight along two generators, a method quite the opposite to the logical way of fitting rolling stock bearings, which should always be backed off on the lower edges so as to prevent them from gripping the journal, and so as to ensure that lubrication commences

at the points where the pressure is lowest.

In the case of a violent « hit up », the disc comes into contact with the box, is bent out of shape, and then fails to function correctly.

The oil retaining collar, shrunk on hot at the back sometimes requires a seating cut out of the axle with a sharp angle, which may start a creeping flaw.

These axle boxes, three times the price of an ordinary box, and of greater weight, increase the tare weight of the stock and thereby the cost of traction, and diminish by an equal weight, the tonnage hauled, which represents over the year, a deficit of thousands of tons on certain workings.

Some railways, which had suffered from hot boxes, are replacing these mechanically lubricated boxes by earlier patterns of ordinary boxes or for trial purposes by roller bearing boxes.

Others require a pad to be fitted in addition : in this case it would be more logical and cheaper to return to the old box which is also much easier to maintain.

In America, various systems of pump lubrication have been tested. Up to the present, none of them has been of any value where wagons are tipped : each time the wagon is tipped, the oil escapes from the box.

Oil tight box with sump.

(*B. O C. patent of the Union Internationale.*)

In order to overcome the drawbacks quoted above, the Committee of railway and trade experts have designed and produced a pattern of axlebox which seems to give the maximum of satisfaction under all conditions and for all purposes, the box in question being suitable for special wagons : tipping wagons, vehicles running in place where the atmosphere is dusty and abrasive, or under very wet conditions, etc.

As will be seen from figure 1 *the oil is imprisoned* as in an automobile sump.

The great difficulty is the back of the box, where it is essential that it should be perfectly tight in order to prevent :

1. *any loss of oil, and*
2. *any entrance of water or dust.*

The problem was solved by fitting a cover which acts as a stuffing box connected to the front cover by four long bolts 16 mm. (5/8 inch) diameter through the body of the box but in the outer part of it.

The stuffing box cover takes its place freely on the inner collar of the journal by means of the play in four vertical slots.

These slots are essential to allow the body of the box to be lifted when removing the brass or when lowering the whole when refitting after lifting to make up for the wear of the brass. It should be stated in passing that this wear is almost negligible since plastic antifriction alloys have been used; the loss being only about 40 gr. per 100 000 km. (2 1/4 ounces per 100 000 miles). It is still further reduced when the action of the abrasive materials inside the box can be got rid of and the introduction of such matter from outside be prevented; this is what is obtained with the sump type box now being described.

The oil tightness is got by the edge of a packing 30 to 40 mm. (1 3/16 to 1 9/16 inches) thick formed of a cupped leather, a felt saturated with oil, a wired cotton ring well tallowed, and finally a leather washer to hold them in place.

The whole packing is pushed on as a fair fit over the inner collar. After being bolted up, the felt, fairly thick at

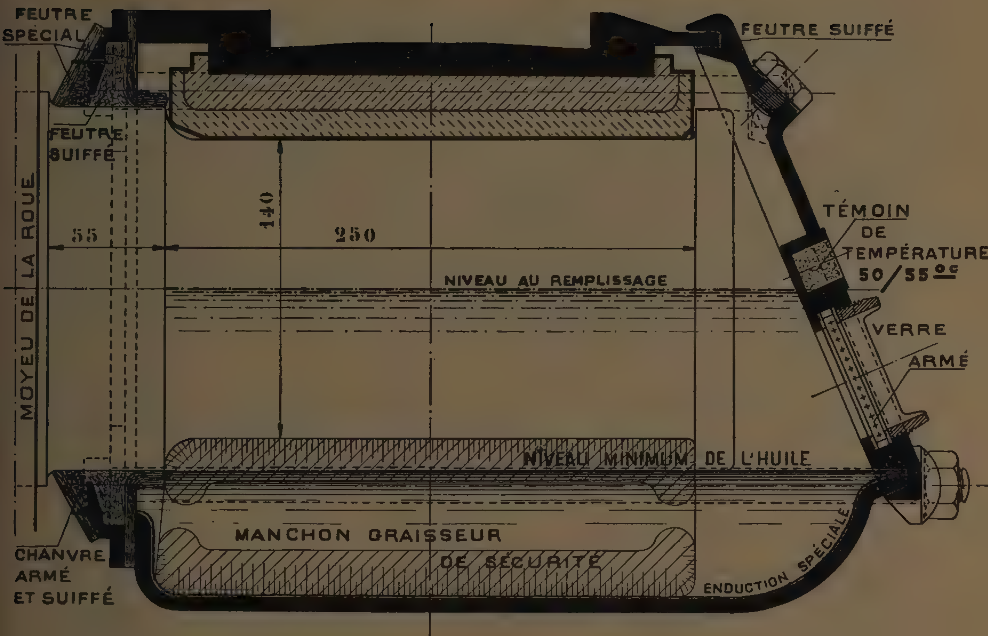

Fig. 1. — Oil and dust tight axle box with sump.

Explanation of French terms : Chanvre armé et suiffé = Reinforced tallowed hemp. — Enduction spéciale = Special enamel. — Feutre spécial = Special felt. — Feutre suiffé = Tallowed felt. — Manchon graisseur de sécurité = Emergency lubricating pad. — Moyeu de la roue = Wheel boss. — Niveau au remplissage = Level after refilling. — Niveau minimum de l'huille = Lowest oil level. — Témoin de température 50/55°c = Heating indicator 122°-131° F. — Verre armé = Armoured glass.

first, becomes compressed in the groove and is forced out onto the axle fanways; this condition is necessary to prevent the felt from hardening by compression at this point, so that it shall not act as a brake nor wear too quickly in spite of the constant flow of oil from the inside of the box to it.

The hole in the metal part of the stuffing box cover is turned 10 mm. (25/64 inch) larger in diameter than that of the inner journal collar which gives 5 mm. (13/64 inch) play round the axle.

This play is ample at the top because the brass wears practically nothing at all and after each lifting the back cover takes its proper position.

Under the journal, the play is much smaller than that of all other axle boxes where 6 to 20 mm. (15/64 to 25/32 inch) is indispensible to get out the drawer and the brass, or the brass when no drawer is used.

The B. O. C. box only having 5 mm. (13/64 inch) play under the axle prevents the drawer accidently getting out

of place, as frequently happens in the case of bogies with the rigid boxes, Diamond pattern, when running round small radius curves, superelevated (as is the rule) and on down gradients, the track being *ipso facto* laid on a sloping surface.

Some rolling stock owners, who have suffered from hot boxes and even derailments, have had a safety stirrup bolted inside the boxes 1 or 2 mm. (3/64 to 5/64 inch) below the journal. This new fitting has satisfied them but they have not yet had their attention drawn to the damage done to the journal by occasional contact with the stirrups which are moreover made of mild steel.

In order to avoid this same difficulty one African railway places a stirrup under the inner journal collar at the same point as the cast steel ring of the B. O. C. box.

Horizontally 5 mm. (13/64 inch) play is also given. This play is ample because in the boxes in service when well designed the play which exists between the journal collar and the inside walls is slightly less.

In the event of a rough shunt, it is obvious that the edge of the felt receives the first shock and will yield slightly though happily not permanently owing to its semi-elasticity.

One of the vertical sides of the box will then strike the collar as there is only 2 to 3 mm. (5/64 to 1/8 inch) play. There is therefore no fear of the back cover getting out of order; this cover made of cast steel being able to stand if need be a violent blow against the cylindrical surface of the axle without any fear of its cracking or breaking.

As the box is sealed at the back, the oil (or semi-fluid grease, or stiff grease, as the case may be) can fill the whole box, *which protects the journal against rusting* when the vehicles stand for some time.

The level of the lubricant can under no circumstances fall below the inner journal collar, the adjacent leather joint being pulled up against the back of the box in a *really efficacious manner* by the back ring.

In the unlikely event of the oil level falling so abnormally, an oiler « emergency » pad, the object of which is to wipe the journal and collect any foreign matter, lubricates by capillarity as in ordinary boxes.

This pad corseted inside it, also provides an appreciable reserve supply of oil owing to its volume of absorbent material : « perfect packing », cotton canvas with woven looped wool pad in contact with the journal; even in the event of a serious leaking from the box itself, lubrication would continue for several months.

It is of course essential that the bottom of the box should be absolutely oil tight. In addition to the usual test by means of a mixture of oil and paraffin required by nearly all specifications, of careful pickling and cleaning and also of blowing out the sand and other residues from the foundry by compressed air, a special enamel, not affected by oil, is applied to the inside of the box by an air sprayer.

This enamel covers over any dirt still remaining, seals them in place definitely, and closes up the inevitable porosity found in steel castings.

The lubricant is introduced through the top of the box, the hole being closed by a screwed in plug. The oil tightness at the front is obtained by a thick packing in tallowed felt placed in a groove in the cover which is then tightened up all round.

In the front cover a reinforced glass inspection cover enables the level of the oil to be seen. In addition, a pocket is provided and is filled with a solidified material which melts and runs out at about 50/55° C. (122 to 131° F.) giving a useful visual signal in order to prevent a heating case.

This axle box is designed to use existing parts : brasses, axle guards, springs, *without any alteration.*

The bulk, weight, and cost are smaller. In order that technical progress may be complete *the exclusive use of stiff grease is to be hoped* for; in this event, the lubrication would be expected to last indefinitely, any loss of grease being almost impossible.

In conclusion, it is to be hoped that the completion of new improvements in railway rolling stock may follow the same progress as in automobile engineering where the increasingly greater demands, and the good results of competition are seen in a rapid and noteworthy technical development.

[625 .23]

REPORT No. 3

(America, British Empire, China and Japan)

ON THE QUESTION OF ALL-STEEL COACHES. — COMPARISON WITH VEHICLES BUILT OF WOOD (SUBJECT VIII FOR DISCUSSION AT THE ELEVENTH SESSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION,

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Figs. 1 to 39, pp. 593 to 662.

CONTENTS.

Clause 1. — Introduction.

Brief reference was made in report No. 5 on Subject VII, submitted to the Ninth Congress of the International Railway Association at Rome, 1922 (Reporter, the late Mr. R. W. Reid), to the fact that a few of the railways dealt with in that report had experimental all-steel carriages under construction (the report did not include America), and also that in addition to all-metal carriages working electrical services in the Manchester (England) District, all-steel carriages were already in use in India; in South Africa, Australia and New Zealand, however, timber was still used for carriages.

The present report covers the practice in the Argentine, Brazil, Chili, China, United States of America, Great Britain, Africa, Australasia, Canada, Ceylon, India, Malay States, Mesopotamia, Japan, Salvador and Uruguay, and is based upon the replies received to the questionnaire which appears at the end of this paper, together with a summary of replies received arranged in order of the various countries.

Clause 2. — History and development.

Amongst the reasons advanced for the introduction of steel carriages, the most important have been :

a) Necessity for making carriages fireproof, especially electric stock working tunnel services;

b) Value from the point of view of reduction in the number of injuries to passengers in cases of collision or derailment;

c) Anticipated shortage of timber, due to virgin forests being used up, and afforestation not having been carried out sufficiently to overcome a possible shortage and consequent anticipated advance in price of timber;

d) Steel being a manufactured production, there is no difficulty in obtaining ample supplies;

e) Anticipated less maintenance cost of steel carriages as compared with wooden carriages;

f) Pressure of public opinion in the direction of ensuring greater safety in railway carriages in the case of collisions;

g) If low maintenance costs are to be obtained with wooden carriages, timber must be properly seasoned. To do this, artificial seasoning must be resorted to, or a large amount of capital locked up in stocks of timber, to naturally season it. This does not apply in the case of steel carriages.

Reasons have also been advanced against the introduction of steel carriages, as follows :

a) That the tare weight would be greater than with a corresponding wooden carriage of a similar type;

b) That rust and corrosion would take place at the joints of the panels and at the back of the interior finishing where condensation can take place, with consequent higher cost of repairs;

c) That they would be hotter in summer and colder in winter, due to quicker heat transference through steel;

d) That they would be found noisier than a similar type of wooden coach;

e) Would not be able to get sufficiently pleasing decorative effect in interior of a coach with steel fittings equivalent to that of a wooden coach.

It will therefore be seen that designers have had to face various problems in de-

signing steel carriages, as for example :

a) To keep the tare weight of a steel carriage to approximately that of a wooden carriage of a similar carrying capacity;

b) To give sufficient protection to the steel panels and steel members by means of paint or other rust-resisting material, so that steel carriages will last at least as long as wooden carriages;

c) To overcome the difficulty of quicker heat transference of metal against wood, *i. e.*, in cold climates, loss of heat involving greater steam consumption, for heating of carriages, and in hot climates, so insulating them to prevent the carriages getting uncomfortably hot;

d) The tendency of steel carriages to « drum » has had to be overcome by providing proper insulation of steel panels;

e) To so design steel carriages that the first cost is a reasonable one compared with wooden carriages.

It is apparent that a great deal of time and study has been given to the question, and from the steps taken in the various countries covered by this report, as indicated below, it will be seen that the all-steel carriage has made considerable progress. A questionnaire was sent to 87 railway administrations; of these, 34 have replied and provided data, 24 have reported that they have no all-steel carriages, and 29 had not replied when this report was submitted.

For the purpose of this report, it has been necessary to lay down a definition as to what is understood by wooden, semi-steel and all-steel carriages, and this is as follows :

Classification.		Description.
1.		*Wooden carriages.* Steel underframe. Wood body.
2.		*Semi-steel carriages.* Steel underframe. Wood body framing. Steel panelling.
3.		*All-steel carriages.*
	A.	Steel underframe. Steel body framing. Steel panelling. Steel interior furnishings.
	B.	Steel underframe. Steel body framing. Steel panelling. Wood interior furnishings.

A summary of the practice adopted by railway companies in the various countries that it has been possible to classify from the replies received, is as follows :

Argentine.

Argentine State Railways (Ferrocarriles del Estado) have a number of semi-steel (Classification 2) carriages in traffic, built in 1922.

Central Argentine Railway. — All-steel carriages (Classification 3-B) have been in use for over two years, and a further quantity of 122 all-steel carriages (Classification 3-B) are now under construc-

tion. It is reported that the clarity of the atmosphere will prove an advantage, except perhaps from a painting point of view, although the results so far have been satisfactory.

China.

The South Manchuria Railway built their last batch of wooden carriages 14 years ago, and about 6 years ago, introduced all-steel carriages (Classification 3-B), which are used on express and through trains.

United States of America.

This country was probably the first to seriously consider all-steel carriages, and the development was broadly as follows :

Year. *Action taken.*

1902. — *Pennsylvania Railroad* built first metal experimental carriage at Altoona for *New York Underground Lines.*

1903. — *Illinois Central Railway* placed a number of steel carriages in service on suburban lines running into Chicago.

1904. — *Interborough Rapid Transit Co.* in conjunction with *Pennsylvania Railroad* were having a carriage built at Altoona prior to orders being placed with American Car and Foundry Co., Berwick.

1905. — *Long Island Railroad* and *New York Central* and *Hudson River Railroad* ordered metal passenger carriages.

1906. — *Pennsylvania Railroad* completed a carriage in June at Altoona which, however, contained a certain amount of wood. Progress made with all-metal carriages by *New York Central.*

1907. — 400 all-steel carriages [Classification 3-(A and B)] under construction and in traffic.

1908. — 500 do. do.

1909. — 629 all-steel carriages [Classification 3-(A and B)].

1910. —	1 117	do.	do.
1911. —	3 133	do.	do.
1912. —	5 347	do.	do.
1913. —	7 271	do.	do.
1914. —	9 492	do.	do.
1915. —	12 900	do.	do.
1916. —	14 286	do.	do.
1917. —	15 754	do.	do.
1918. —	17 601	do.	do.
1919. —	18 652	do.	do.
1920. —	18 751	do.	do.
1921. —	19 652	do.	do.
1922. —	20 569	do.	do.
1923. —	21 497	do.	do.
1924. —	22 491	do.	do.
1925. —	24 916	do.	do.
1926. —	26 193	do.	do.
1927. —	23 155 (1)	do.	do.

and the latest figure published for 30 September 1928, is 26 080.

Figure 1 shews the rate of progress.

The position regarding the steel carriages in traffic and under construction on the various railways is as follows :

The Baltimore and Ohio Railroad. — All carriages built since 1911 have been of all-steel (Classification 3-A), and there are now 352 carriages of this description in traffic.

The Delaware and Hudson Company. — 18 all-steel carriages (Classification 3-A), 6 baggage and 6 mail and baggage carriages were constructed in 1916.

Erie Railroad. — Composite wood and steel carriages were built in 1917 and 1918, but in 1928, all-steel carriages (Classification 3-A) were constructed, and there are now 346 all-steel carriages (Classification 3-A) in traffic.

Lehigh Valley Railroad. — The first all-steel carriages (Classification 3-A)

(1) This figure is as communicated.

Fig. 1. — Progress of steel carriage construction in the United States of America.

were constructed 15 years ago, and this Company have no wooden equipment in regular passenger service at the present time, there being 336 all-steel carriages (Classification 3-A) in service.

Long Island Railroad. — Have 1 374 all-steel carriages (Classification 3-A) in traffic, and no wooden carriages.

New York Central Railroad. — Have a total of 1 346 all-steel carriages (Classification 3-B) in traffic.

Norfolk & Western Railway.

Constructed the first three business carriages all-steel (Classification 3-A) in 1911, and have now 244 all-steel carriages (Classification 3-A) in service.

Pennsylvania Railroad System. — Have now 5 457 all-steel carriages (Classification 3-A) in service, besides 300 on order, and in fact, all carriages built since 1904 have been of all-steel (Classification 3-A) construction.

Reading Company. — Have had 15 years' experience of all-steel carriages (Classification 3-A), the total stock of this class of carriage being 494.

Richmond, Fredericksburg and Potomac Railroad. — Have 63 all-steel car-

riages (Classification 3-A) in service, and have built no passenger carriages of wood since 1910-1911, having adopted the policy of steel construction since 1915.

Wabash Railway. — Have now 146 passenger carriages in traffic, and during the last 12-15 years, have only built all-steel carriages (Classification 3-A).

From an examination of the replies received to the Questionnaire, is is found that approximately 50 % of the passenger carriages owned by those companies who have furnished data, are of all-steel construction.

Great Britain.

Great Western Railway. — Have only built one experimental all-steel carriage (Classification 3-B), but report that this was found to be considerably heavier and more costly than their standard vehicles; this vehicle had outside panelling of steel, but inside partitions and panels of wood, with usual upholstery.

London Midland & Scottish Railway. — Have 75 semi-steel (Classification 2) electric motors and trailers, 66 all-steel (Classification 3-A) electric motor and trailer carriages, besides 235 vestibule carriages and 200 passenger brake vans of all-steel (Classification 3-B), and a further 100 on order which will be in traffic by January 1930.

London & North Eastern Railway. — Built 3 kitchen cars in 1914, and have 119 all-steel carriages (Classification 3-B) in service.

Southern Railway. — Have no all-steel carriages, but the standard stock (semi-steel, classification 2) have steel underframes with bodies formed of hard wood and fitted with galvanized panels. Galvanized corrugated steel plates 0.0625 inch thick are used to form the floor, to which are secured bonding strips, the covering being of fireproof composition of a total thickness of 1 1/4 inches.

Metropolitan Railway. — The greater proportion of the stock is built with steel underframes and wooden bodies, there being only six all-steel motors and twelve trailers (Classification 3-B) in traffic.

Underground Electric Railways Company of London.—Built wooden stock from 1904-1906, but from 1910 to 1927, stock has been constructed of all-steel (Classification 3-B), the present stock consisting of 1 734 carriages.

Africa.

Gold Coast Government Railway. — Have six all-steel carriages (Classification 3-B) of the open saloon type in traffic, built in 1925, which have given satisfactory results.

Nigerian Railway. — Have 21 third class all-steel carriages (Classification 3-B) on order, together with 8 sleeping cars.

South African Railways & Harbours. — Have 13 all-steel carriages (Classification 3-B) built in 1923, which are looked upon as experimental. The last wooden carriages were built in 1927.

Sudan Government Railways and Steamers. — Have 27 all-steel carriages (Classification 3-B) in traffic, built from 1923 to 1928.

Australasia.

New South Wales Government Railways and Tramways. — Are using all-steel carriages (Classification 3-A) for suburban electric services, and anticipate having 600 in service before January 1930.

Canada.

Canadian National Railways. — Only all-steel carriages (Classification 3-B) built since 1914, of which the present stock is 841.

India.

Bombay, Baroda and Central India Railway. — Received a number of all-steel carriages (Classification 3-B) from England in 1927, and anticipate having 160 carriages of this classification in traffic by January 1930.

Eastern Bengal Railway. — 14 all-steel carriages (Classification 3-B) were built in 1919 for use on broad and metre gauges, but no more are being considered at present.

East Indian Railway. — 110 all-steel carriages (Classification 3-B) were ordered in March 1927, and are now under construction.

Great Indian Peninsula Railway. — Built their first all-steel carriages (Classification 3-B) in 1914; others in 1922 and 1926-1927, and now there are 180 bogie carriages in traffic.

North Western Railway (State Railway of India). — Built stock 1927-1928 of all-steel (Classification 3-B), and there are now 115 carriages of this classification in traffic.

South Indian Railway. — Have 21 all-steel carriages (Classification 3-B) built in 1927 and 1928.

Japan.

Japanese Government Railways. — 556 all-steel carriages (Classification 3-B) were constructed in 1927, and a further 670 in 1928, making a total of 1 226 all-steel carriages (Classification 3-B) in traffic, including 221 vehicles used on electric services.

Clause 3. — Types of steel and semi-steel carriages in traffic and under consideration. Comparison with modern wooden stock.

Comparative data of wooden, semi-steel and all-steel carriages in service in the various countries has been compiled, and is set out below (table I):

TABLE

COUNTRY				
Railway	State Railways.		Buenos Ayres & Pacific.	
Type of carriage	Wood.	Semi-steel.	Wood.	
Classification	1	2	1	1
Class of passenger	First.	First.	First.	Second
Services operated	General.	General.	Local.	Local.
Doors	End.	End.	End and central side.	End and central side.
Approximate date built	...	1922.	1927.	1927.
Length over buffers	67′-4″	62′-7 1/2″	78′-4″	78′-4″
Length over headstocks	66′-3 3/8″	61′-6 3/4″	77′-0″	77′-0″
Extreme height above rails	12′-2 7/8″	12′-6″	13′-7 3/4′ over roof.	13′-7 3/4″ over roof.
Inside dimensions of body: Length	59′-6″	53′-9″	69′-4″	69′-4″
Width in centre	7′-9 3/4″	7′-10 7/16″	9′-9″	9′-9″
Height from floor	...	...	9′-1 1/4″	9′-1 1/4″
Area of floor space, sq. feet	465	425	632	632
Tare of vehicle, lb.	...	60 480	98 615	95 634
Bogie type, 4 or 6 wheel	6	4	4	4
Bogie weight, each, lb.	...	...	6 847	6 847
Seats	60 First.	49 First.	96 First	116 Second.
Weight: Per metre over headstocks, lb.	...	3 223	4 206	4 081
Per passenger, lb.	...	1 234	1 027	822
Per sq. metre of floor area, lb.	...	1 532	1 683	1 628
Number of carriages built or before 1930.	...	14	...	...

I.

ARGENTINE.				CHINA			
Central Argentine.				South Manchuria			
Wood.	All-steel.	Wood.	All-steel.	Wood.	All-steel.	Wood.	All-steel
1	3-B	1	3-B	1	3-B	1	3-B
First.	First.	Second.	Second.	Third.	Third.	Second.	Second.
Express and district.	Express and district.	Express and district.	Express and district	Local.	Express and through	Local.	Express and through.
. .	Double side and single side at each end.	. .	Double side and single side at each end.	End.	End.	End.	End.
. .	.	. .	. . .	1906-1910	1921-1928	1917-1918	1928
79′-4″	79′-4″	79′-4″	79′-4″	67′-1 1/16″	68′-5 3/16″	68′-0 1/2″	68′-5 3/16″
76′-0″	76′-0″	76′-0″	76′-0″	65′-1 7/16″	66′-5 9/16″	66′-0 7/8″	66′-5 9/16″
13′-2 1/4″	13′-2 1/4″	13′-2 1/4″	13′-2 1/4″	13′-11 1/4″	14′-4 7/16″	14′-2 5/8″	14′-4 7/16″
69′-2″	69′-2″	69′-2″	69′-2″	49′-7 5/8″	50′-10 1/4″	50′-3 3/8″	49′-10 7/16″
9′-6 1/4″	9′-6 1/4″	9′-6 1/4″	9′-6 1/4″	8′-5 3/16″	9′-1 3/4″	9′-1 1/2″	9′-1 3/8″
8′-10″	8′-10″	8′-10″	8′-10″	9′-6 1/2″	9′-6 1/16″	9′-6 1/2″	9′-4 5/16″
658	658	658	658	419	465	459	454
94 080	99 680	87 360	92 960	62 260	96 800	88 000	110 000
4	4	4	4	4	4	4	4
12 488	12 488	12 488	12 488	9 680	13 200	13 200	13 200
80 First.	96 First.	138 Second.	138 Second.	92 Third.	80 Third.	72 Second.	64 Second.
4 054	4 300	3 763	4 009	3 045	4 640	4 235	5 273
1 176	1 041	633	672	669	1 210	1 223	1 718
1 515	1 635	1 433	1 523	1 597	2 237	2061	2 603
131				. . .	91	. . .	17

TABLE I.

Country	UNITED STATES					
Railway	Baltimore and Ohio	Delaware and Hudson.		Erie.		
Type of carriage.	All-steel	Wood.	All-steel.	Semi-steel.	All-steel.	Semi-steel.
Classification	3-A	1	3-A	2	3-A	2
Class of passenger	First.	...	...			
Services operated	All.	...	...	Fast.	Fast.	Suburban.
Doors	End.	End.	End.	End.	End.	End
Approximate date built	1927	1907	1916	1912	1926	1913
Length over buffers	79'-11 1/8"	78'-8 1/2"	81'-0 1/2"	78'-5 1/2"	78'-7 3/4"	68'-0 7/8"
Length over headstocks	Approx. 78'-0"	77'-6"	79'-10"	76'-6 1/2"	76'-8 3/4"	66'-1 7/8"
Extreme height above rails	13'-11 3/4"	14'-3 1/2"	14'-1 3/4"	14'-4 15/16"	14'-2 1/16"	14'-4 15/16"
Inside dimensions of body Length	69'-3 3/4"	69'-1"	71'-11 7/8"	69'-4"	69'-3 3/8"	59'-2 3/8"
Width in centre	9'-1"	8'-10 1/2"	8'-10 5/8"	8'-9 3/8"	8'-11 3/8"	8'-9 3/8"
Height from floor	9'-3"	...	.	9'-7 5/8"	9'-6 1/16"	9'-7 5/8"
Area of floor space, sq. feet	630	612	639	609	620	520
Tare of vehicle, lb.	151 300	108 800	139 000	114 000	141 000	88 500
Bogie type, 4 or 6 wheel	6	6	6	6	6	4
Bogie weight, each, lb.	22 925	18 150	23 080	22 400	23 100	16 300
Seats	80 First.	82 passengers.	90 passengers.	73 passengers.	73 with smoker, 84 without smoker.	94 passengers.
Weight : Per metre over headstocks, lb.	6 364	4 606	5 713	4 886	6 051	4 389
Per passenger, lb.	1 891	1 327	1 514	1 561	1 678	941
Per sq. metre of floor area, lb.	2 585	1 914	2 342	2 017	2 447	1 843
Number of carriages built or before 1930.	352	...	9	..	44	..

Continued.)

F AMERICA.	Lehigh Valley.	Long Island.		New-York Central.	Norfolk and Western.		Pennsylvania.	Reading.	Richmond Fredksbg. and Potomac.	Wabash.
ll-steel.	All-steel.	All-steel electric	All-steel steam.	All-steel	Wood	All-steel.	All-steel.	All-steel.	All-steel.	All-steel.
3-A	3-A	3-A	3-A	3-B	1	3-A.	3-A.	3-A.	3-A.	3-A.
All one class.							First.	De-luxe.	First.	First.
burban.	All.	...	...	Main line & electric suburban.	Local & branch.	Through.	All.	Suburban and light.	Express.	Express.
End.	End.	End and side.	End and side.	End and side.	End.	End.	End and side.	End and side.	End.	End.
1928	1924-25	1920-27	1926	Elec. 1906 Main 1912-28	1887-1907	1913-26	Since 1904 First main line 1907	1913-1927	1923 & 1926	From 1913
8'-7 3/4"	78'-10 1/2"	64'-5 1/4"	64'-5 1/4"	78'-7 3/4"	61'-6 1/2"	80'-0 5/16"	80'-3 3/4"	72'-5 1/2"	83'-10 3/4"	Approx. 81'-2"
6'-8 3/4"	77'-0"	63'-4 3/4"	63'-4 3/4"	...	60'-6 1/2"	79'-0 5/16"	78'-3 3/4"	Estimated 70'-9 1/2"	81'-10 3/4"	Approx. 79'-6"
13'-3"	13'-11 1/16"	13'-8 1/4"	13'-8 1/4"	14'-2"	13'-11 1/2"	14'-0 1/2"	14'-0 1/2"	13'-4 7/8"	14'-1 1/2"	...
6'-0 1/4"	69'-4"	54'-2 1/2"	54'-2 1/2"	69'-3"	52'-0 1/2"	69'-11 1/2"	69'-7 1/2"	62'-2 7/8"	Estimated 73'-1 1/2"	71'-9"
-10 3/4"	9'-2 1/8"	9'-8 1/2"	9'-8 1/2"	8'-11 3/8"	9'-3"	9'-3 3/4"	9'-1"	9'-0 7/8"	9'-0 7/8"	..
-8 1/8"	...	8'-7 1/16"	8'-7 1/16"	9'-5 3/8"	...	...	9'-5 1/4"	8'-10 1/2"	...	...
587	638	526	526	620	481	627	632	564	663	634
00 900	109 705	...	...	131 000	94 800	150 000	122 000	116 000	148 000	147 400
4	4	4	4	4	6	6	4	4	6	
13 350	...	...	...	17 000	...	...	15 500	17 470	Approx. 20 000	..
111 passengers.	80 passengers.	78 passengers.	76 passengers.	85 passengers.	62 passengers.	78 passengers.	88 First.	77 First.	88 First.	84 First.
4 314	4 674	5 849	4 037	5 440	5 138	6 227	5 111	5 376	5 929	6 083
909	1 371	1 476	1 045	1 540	1 529	1 923	1 386	1 506	1 682	1 755
1 851	1 851	2 357	1 626	2 270	2 121	2 577	2 078	2 211	2 403	2 503
271	199	All types : 1 374		All types 1 346	..	92	...	494	8	23

TABLE I.

COUNTRY	GREA[T BRITAIN]			
Railway	London Midland & Scottish.			
Type of carriage	Wood, driving trailer.	All-steel, driving trailer.	Wood, brake van.	All-steel, brake van.
Classification	1	3-A	- 1	3-B
Class of passenger	Third.	Third.		
Services operated	Express and suburban.	Express and suburban.	Express.	Express.
Doors	End.	End.	Side.	Side.
Approximate date built	1912	Up to 1920.	Up to 1928.	1928
Length over buffers	65'-3"	65'-3"	53'-8"	53'-8"
Length over headstocks	63'-7"	63'-7"	50'-0"	50'-0"
Extreme height above rails	12'-7 7/8"	12'-4 1/2"	12'-4 3/4"	12'-4 3/4"
Inside dimensions of body : Length	63'-1"	63'-2 1/2"	49'-6 1/2"	49'-5"
Width in centre	9'-3 1/4"	8'-11 1/8"	7'-11"	7'-11"
Height from floor	8'-3 1/4"	8'-3 1/4"	8'-0 1/2"	7'-10 1/32"
Area of floor space, sq. feet	548	560	376	370
Tare of vehicle, lb.	61 768	64 960	54 995	63 896
Bogie, type, 4 or 6-wheel	4	4	4	4
Bogie weight, each, lb.	11 228	11 228	11 200	11 200
Seats	97 Third.	95 Third.		
Weight : Per metre over headstocks, lb.	3 187	3 351	3 609	4 193
Per passenger, lb.	637	684		
Per sq. metre of floor area, lb.	1 213	1 249	1 578	1 859
Number of carriages built or before 1930		All types : 66		300

(Continued.)

RITAIN.

		London and North Eastern.		Metropolitan.		Underground.	
Wood, vestibule.	All steel, vestibule.	Wood.	All-steel.	Wood, trailer.	All-steel, trailer.	Steel, trailer.	Steel, trailer.
1	3-B	1	3-B	1	3-B	3-B	3-B
Third.	Third.	Open third.	Open third.	Third.	Third.		
Express.	Express.	Express.	Express.	District.	District.	District and suburban.	District and suburban.
End.	End.	End.	End.	Large sliding side.	Swing end gates and single centre sliding door.	Side	Side.
1924	1925	1925/6	1927	1922	1904	1924	1925
60'-8"	60'-8"	63'-6"	63'-6"	52'-10"	50'-8 1/4"	51'-5 1/2"	51'-5 1/2"
57'-0"	57'-0"	60'-0"	60'-0"	50'-10"	49'-0"	49'-9 1/4"	49'-9 1/4"
12'-4 3/4"	12'-4 3/4"	12'-6"	12'-6"	12'-4"	12'-4 1/2"	9'-5 7/8"	9'-6"
56'-6 1/2"	56'-6 1/2"	Estimated : 61'-0"	Estimated : 61'-0"	51'-0 3/8"	49'-0"	49'-3"	49'-3"
8'-5"	8'-4"	8'-6" estimated.	8'-9" estimated.	8'-1 1/4"	8'-9"	8'-0 1/2"	8'-0 1/2"
7'-10"	7'-10 1/2"			7'-11 9/16"	8'-6"	7'-1"	7'-1"
460	460	469	489	413	426	392	392
61 656	67 872	72 800	76 608	50 400	42 560	40 880	42 028
4	4	4	4	4	4	4	4
11 200	11 200			7 840	7 728		
42 Third.	42 Third.	48 Third.	64 Third:	50 Third.	64 Third.	48 passengers.	48 passengers.
3 549	3 905	3 981	4 188	3 253	2 849	2 693	2 769
1 468	1 616	1 516	1 197	1 008	686	851	876
1 443	1 588	1 671	1 684	1 312	1 075	1 122	1 154
	200	9	21		12		

Table I.

Country				
Railway	Gold Coast Government.		Nigerian.	
Type of carriage	Wood.	All-steel	Wood.	All-steel.
Classification	1	3-B	1	3-B
Class of passenger	First	Third.	Third.	Third
Services operated	Fast.	Fast.	...	Suburban.
Doors	End Corridor.	End open Saloon.	End.	End.
Approximate date built	1925	1925	...	1928
Length over buffers	59'-9"	59'-9'	59'4"	59'-4"
Length over headstocks	56'-3"	56'-3"	56'-3"	56'-3"
Extreme height above rails	12'-0 1/8"	12'-0"	12'-0"	12'-0"
Inside dimensions of body : Length	50'-7"	50'-5"	50'-7"	50'-7"
Width in centre	8'-3	8'-0 1/8"	8'-3"	8'-3"
Height from floor	8'-2"	8'-4 1/2"	...	...
Area of floor space, sq. feet	417	407	383	383
Tare of vehicle, lb.	58 884	49 336	44 464	51 100
Bogie type, 4 or 6 wheel	4	4	4	4
Bogie weight, eaach, lb.	7 868	7 868	6 314	7 812
Seats	22 First.	114 Third.	93 Third.	114 Third.
Weight : Per metre over headstocks, lb.	3 434	2 878	2 593	2 980
Per passenger, lb.	2 677	432	478	448
Per sq. metre of floor area, lb.	1 520	1 305	1 249	1 436
Number of carriages built or before 1930.	...	6	...	21

(Continued.)

...FRICA.					AUSTRALASIA.		CANADA.
South African Railways & Harbours.		Sudan Government Railways.			New South Wales. Government Railways.		Canadian National.
Wood.	All-steel.	All-steel.			Wood.	All-steel.	All-steel.
1	3-B.	3-B.			1	3-B.	3-B
Saloon.	Saloon.	Second.	Third.	Fourth.	Corridor Saloon.	Trailer.	...
Main line & Suburban.	Main line & Suburban.	...	...	...	Express Mail & General.	Suburban.	All.
End.	End.	End through Corridor.	End open with two Saloons.	End Saloon.	Side & End.	Side & End.	End.
1927	1923	1924	1924	1923	1928	1928	...
65'-8"	65'-8"	60'-5 1/8"	60'-5 1/8"	50'-2 1/2"	68'-4 1/2"	63'-7 3/4"	83'-10"
63'-5"	63'-5"	57'-6"	57'-6"	47'-0"	65'-0"	61'-6"	82'-0"
12'-5 3/16"	12'-5 3/16"	12'-2 1/2"	12'-2 1/2"	11'-0 7/8"	13'-5"	12'-10 1/2"	14'-1 1/2"
56'-11"	57'-1"	56'-10 5/16"	56'-10 5/16"	41'-5"	65'-10"	61'-0 1/2"	72'-8"
8'-0"	8'-3"	8'-2 1/4	8'-2 7/8"	8'-5 7/8"	8'-6 5/8"	9' 7 1/4"	9'-1"
8'-3 3/8"	8'-3 3/4	8'-3 5/16"	8'-3 5/16"	7'-6 1/2"	8'-10 3/4"	8'-3 1/8"	...
446	452	276	245	352	550	567	659
73 000	81 000	64 456	57 344	43 792	88 060	78 400	...
...	...	4	4	4	4	4	6
9 075	9 075	8 022	8 022	7 840	...	...	...
39 First, 26 Berths.	39 First, 26 Berths.	56 Second.	60 Third.	100 Fourth.	42 First, 64 Second.	79 First, 79 Second.	44 First, 40 Second.
3 777	4 190	3 640	3 276	3 058	4 444	4 179	...
Seats : 1 872 Berths : 2 807	Seats : 2 077 Berths : 3 115	1 148	952	438	First : 2 097 Second : 1 376	First : 993 Second : 993	...
1 762	1929	1 456	1 288	1 342	1 723	1 488	...
...	13	2	3	...	...	250	All types 841

TABLE I

COUNTRY							
Railway	Bombay Baroda and Central India.		Eastern Bengal.				Ea
Type of carriage. . .	All-steel.		Wood.	All-steel.	Wood.	All-Steel.	A
Classification	3-B.		1	3-B.	1	3-B.	
			Broad gauge.		Metre gauge.		
Class of passenger . .	First and Second control trailer.	Second and Third. trailer.			Third.	Third.	Third.
Services operated . .	Suburban.	Suburban.	General.	General	General.	General.	Main line.
Doors	Side.	Side.					Inward hinged
Approximate date built	1927	1927	1927	1919	1927	1919	1926
Length over buffers .	71'-0 1/8"	71'-0 1/8"	72'-2"	71'-7"	59'-6"	57'-3 1/2"	72'-0 1/2"
Length over headstocks	67-10 1/2"	67'-10 1/2"	68'-0"	67'-5"	56'-6"	53'-4"	67'-10 1/2"
Extreme height above rails.	13'-8"	13'-8"	12'-8 3/8"	12'-10"	10'-10 7/8"	10'-8 3/8"	12'-9 5/16"
Inside dimensions of body. Length	67'-2 1/4"	67'-2 1/4"	67'-4"	67'-5"	56'-4"	54'-6"	67'-4"
Width in centre. . .	11'-3"	11'-3"	8'-9"	8'-10 1/2"	7'-3"	7'-4"	9'-1 1/4"
Height from floor. . .	8'-10 5/8"	8'-10 5/8"	8'-0 1/2"	8'-0 1/4"	7'-5"	7'-4 9/16"	8'-0 3/16"
Area of floor space, sq. feet.	758	758	594	690	408	411	603
Tare of vehicle, lb. .	101 136	97 104	76 160	78 568	47 040	40 376	80 528
Bogie type, 4 or 6 wheel.	4	4	4	4	4	4	4
Bogie weight, each, lb.			13 440	13 440	10 080	10 080	12 992
Seats	18 First, 90 Second.	25 Second, 110 Third.	39 Inter. First, 63 Inter. Third.	44 Inter. First, 54 Inter. Third.	72 Third.	80 Third.	114 Third.
Weight . . . . Per metre over headstocks, lb.	4 888	4 693	3 584	3 920	2 688	2 486	3 886
Per passenger, lb. . .	936	719	627	717	650	493	705
Per sq. metre of floor area, lb.	1 436	1 379	1 523	1 210	1 299	1 053	1 438
Number of carriages built or before 1930.				ø		ø	55

ø Total all steel, 3B = 14.

(Continued.)

INDIA.

...ndian.		Great Indian Peninsula.			North Western.		South Indian.			
...teel.		All-steel.			All-steel.		Wood.	All-steel.	Wood.	All-steel.
...3-B.		3-B.			3-B.		1	3-B.	1	3-B.
Third and Inter.	Third and brake.	First Second and Third control trailer.	Third driving trailer.	Third.	Third.	Third and brake.	First and Second composite.	First and Second composite.	Third.	Third.
Main line.	Main line.	Suburban.	Suburban.	Suburban.	Main line.	Main line.	All.	Suburban.	All.	Suburban.
Inward hinged.	nward. hinged.	End and side.	End and side.	End and side.	Inward hinged.	Inward hinged.	Side without corridors.	Wide side in centre and narrow without corridors.	Side without corridors.	Wide side in centre and narrow without corridors.
1926	1926	1925	1925	1927	1926	1926	1924-27	1927	1924 27	1927
72'-0 1/2"	72'-0 1/2"	70'-11"	70'-11"	72'-0 1/2"	72'-0 1/2"	72'-0 1/2"	53'-11 7/8"	60'-5 7/8"	53'-11 7/8"	60'-5 7/8"
67'-10 1/2"	67'-10 1/2"	67'-10 1/2"	67'-10 1/2"	67'-10 1/2"	67'-10 1/2"	67'-10 1/2"	50'-0"	56'-6"	50'-0"	56'-6"
12'-9 5/16"	12'-9 5 16"	13'-8"	13'-8"	12'-9"	12'-9 5/16"	12'-9 5/16"	10'-7 1/2"	10'-8 1/4"	10'-7 1/2"	10'-8 1/4"
67'-4"	67'-4"	67'-0"	67'-0"	67'-0"	67'-4"	67'-4"	50'-11"	56'-6"	50'-6"	56'-6"
9'-1 1 4"	9'-1 5/8"	11'-0"	11'-0"	9'-3"	9'-1 1/4"	9'-1 5/8"	7'-5 3/4"	7'-8 1/8"	7'-9'	7'-8 1 8"
8'-0 3/16"	8'-0 3/16"				8'-0 3/16"	8'-0 3/16"	7'-6 3/8"	7'-7 11/16"	7'-9 1/4"	7'-7 11/16"
603	603	719	719	602	603	603	379	400	376	400
80 976	87 024	96 656	95 088	87 136	80 528	87 024	48 720	52 080	40 880	47 600
4	4	4	4	4	4	4	4	4	4	4
12 992	12 992				12 992	12 992	6 720	6 720	6 720	6 720
32 Third, 62 inter.	65 Third.	15 First, 42 Second, 42 Third.	120 Third.	116 Third.	114 Third.	65 Third.	6 First, 24 Second.	12 First, 36 Second.	80 Third.	88 Third.
3 909	4 200	4 672	4 595	4 212	3 886	4 200	3 198	3 024	2 684	2 764
862	1 339	976	792	751	705	1 339	1 624	1 086	511	541
							Calculated.			
1 446	1 553	1 447	1 424	1 558	1 438	1 553	1 384	1 402	1 170	1 281
11	22				115 Both types.					

TABLE I. *(Continued.)*

COUNTRY	MALAY.	JAPAN.			
Railway	Federaded Malay States.	Government of Japan. Department of Railways.			
Type of carriage	Wood.	All-steel.			
Classification	1	3-B.			
Class of passengers	Third.	Second sleeper.	Second.	Third.	Third.
Services operated	All.	General.	General.	General.	General.
Doors	End. Also side saloon.	End.	End.	End.	Large side.
Approximate date built	Standard since 1926.	1928	1927-28	1927-28	1927
Length over buffers	62'-5 11/16"	65'-7 3/8"	55'-9 1 4"	55'-9 1/4"	55'-9 1/4"
Length over headstocks	60'-0"	63'-11 11/16"	54' 1 5/8"	54'-1 5/8"	53'-1 13/16"
Extreme height above rails	11'-8	12'-10 1/2"	12'-10 1/2"	12'-10 1/2"	12'-3 5/8"
Inside dimensions of body: Length	54'-0"	56'-9 1/8"	46'-11"	46'-11'	Estimated 46'-1"
Width in centre	8'-4"	8'-6 5/8"	8'-6 1/4"	8'-6 1/4"	8'-6 11/16"
Height from floor	7'-11 1/4"	8'-8 7/16"	8'-8 7/16"	8'-8 7/16"	8'-1 1/4"
Area of floor space, sq. feet	451	485	399	399	449
Tare of vehicle, lb.	Estimated. 59 292	92 646	66 685	63 728	58 464
Bogie type, 4 or 6 wheel	4	6	4	4	4
Bogie weight, each, lb.	...	...	...	...	...
Seats	108 Third.	40 Second.	52 Second.	80 Third.	48 Third.
Weight: Per metre over headstocks, lb.	3 628	4 749	4 054	3 875	3 606
Per passenger, lb.	549	2 195	1 277	806	493
Per sq. metre of floor area, lb.	1 547	2 061	1 792	1 725	1 411
Number of carriages built or before 1930	...	40	138	404	45

Clause 4. — Designs, methods of construction, and materials used.

a) General survey of designs adopted.

Argentine.

Argentine State Railways (Ferrocarriles del Estado). — The semi-steel carriages (Classification 2) are constructed with a strong central longitudinal solebar fitted with trussbars, the principal materials used being sheet steel plates, pressings and malleable castings.

Central Argentine Railway. — This railway reports that the rigidity of the carriage sides forms a truss, and there is no working of the members of the body, such as is experienced with a body of wooden construction, and which results in greater maintenance costs to louvres and interior finish than is the case with an all-steel carriage. The principle here adopted differs very little from the practice for steel underframe and wooden-bodied stock, except that truss rods are abolished, and steel framing and panelling are introduced for the body, which supports the weight. The strength of the underframe has been retained to deal with the buffing shocks met with. No special design such as latticing or tubular construction has been introduced, whilst stock is fitted with end doors generally. Mild steel roof and side plates are used, the main framing being in pressed steel.

China.

South Manchuria Railway. — All-steel carriages (Classification 3-B) (fig. 2) are used, and the end has been strengthened, as well as the body framing, to provide for protection against telescoping, derailment, etc. The underframes are of the built-up type, steel plates, angles and pressed steel plates being used. The centre sill is of the fish-belly type, whilst the body framing consists of steel plates, angles and pressed steel securely riveted together on to the underframe. Steel plates are used for outside panelling of both ends and roof, but wood is used for interior finish.

United States of America.

Baltimore and Ohio Railroad. — This Company have standardized on the built-up type of steel underframe constructed of plates, standard angles, « Z » bars and pressed channels, fish-belly type centre sills, and cast steel buffer beams. The body framing is built up of plates, standard angles and pressed channels. The material consists of mild steel containing 0.20 % copper (fig. 3).

Delaware & Hudson. — The fish-belly type of underframe has been adopted, rolled and pressed steel shapes are used, as well as cast steel for constructional purposes.

Erie Railroad. — This company also have adopted the fish-belly type of underframe. Rolled steel in the form of angles, « H » beams and « Z » bars is used, as well as pressed steel members, together with cast steel, cast iron and malleable cast iron (fig. 4).

Lehigh Valley Railroad. — The underframe with superstructure is built of plates riveted to angles, channels and tee iron. The body framing is built of sheet steel, moulded patterns being used. It is reported that the development of the design has been based on experience, and brought about by the demand for heavier and stronger carriages. Underframes and superstructures have been strengthened, all-steel carriages are being used in place of a combination of wood and steel, draft gears improved, and in fact, the design

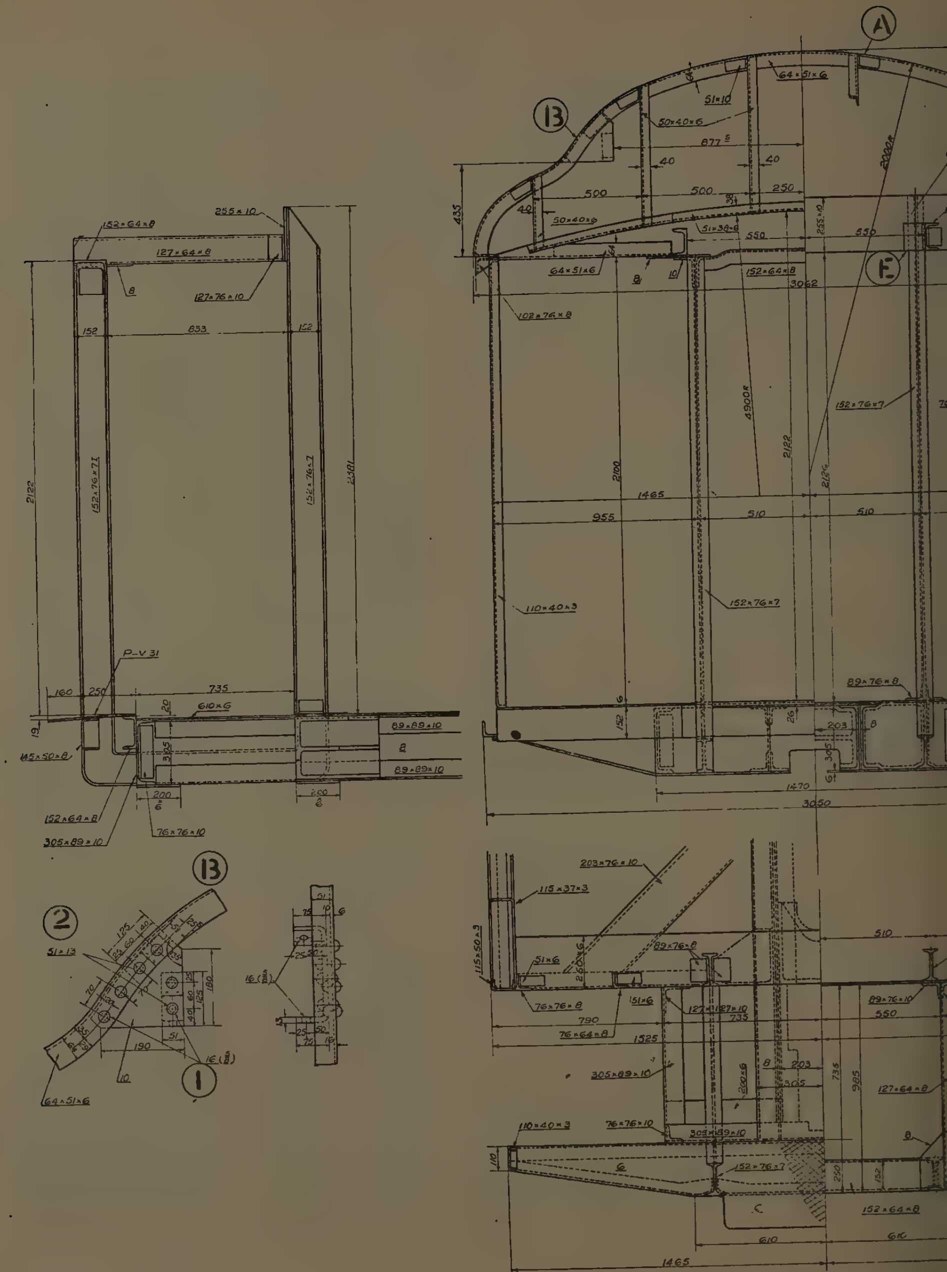
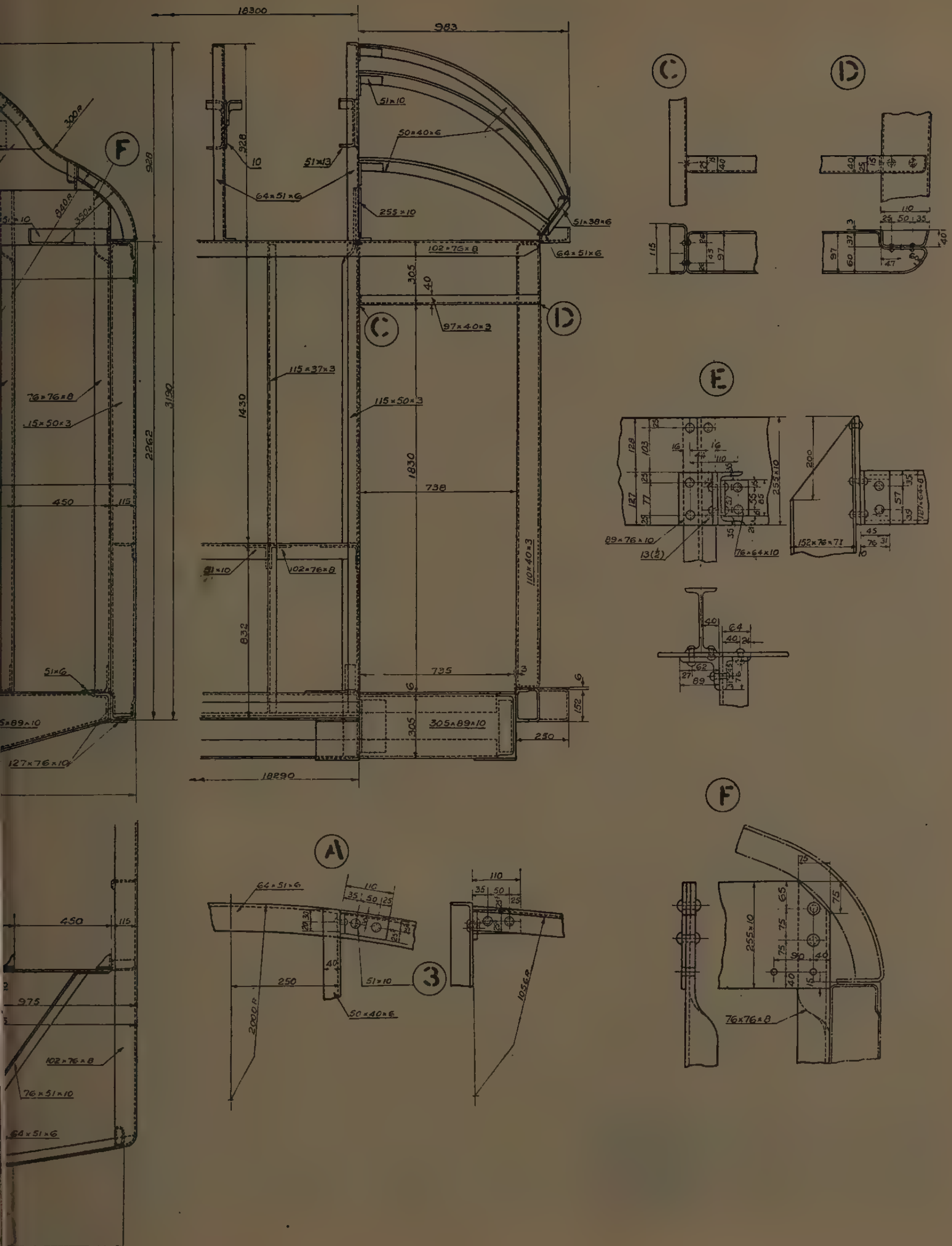


Fig. 2. — Vestibule framing and end platform st



passenger carriages, South Manchuria Railway.

improved in general with a view to reducing breakage and repairs.

Long Island Railroad. — Favour a strong underframe and light body. The box girder centre sill extends from end to end, to which are attached cantilever cross-ties supporting floor and side frame. Carlines and purlines are built of pressed steel shapes, and are all riveted and held together by steel sheets.

New York Central Railroad. — Fish-belly type centre sills are used, uniform section side sills, side frame girder tied to centre sills by means of crossbearers. Open hearth rolled steel bars and shapes, steel plates, flat and pressed steel and malleable castings are used (fig. 5).

Norfolk and Western Railway. — Have a combination of load-carrying side girders and centre sills. Rolled sections, pressed shapes, and malleable and steel castings are chiefly used.

Pennsylvania Railroad. — Use a box girder centre sill extending from end to end, consisting of two 18-inch channels with cover plates riveted on top and bottom. Attached to the box girder are cantilevers supporting the superstructure. This company uses rolled sections, pressed shapes and flat sheets made of copper bearing open hearth steel, also iron, steel and malleable castings (figs. 6 and 7).

Reading Company. — Favour an underframe of the fish-belly type. Rolled and pressed steel members are used, with steel castings and some malleable iron.

Richmond, Fredericksburg and Potomac Railroad. — Adopt heavy centre sills designed as main carrying members. The end framing is of heavy construction, but side framing is fairly light, with roof carlines of pressed or rolled steel. Open hearth steel plates and rolled shapes are principally used. Steel castings are preferred to gray or malleable iron. Light plates pressed to pattern are used for interior finish.

Wabash Railway. — The earlier type of carriage had underframe girders formed of « I » beams, with superstructure largely of angle iron. Later designs had centre girders built up of plates and angles, with body framing of pressed shapes, the object being to obtain increased strength and reduce vibration. The inside furnishings and doors are of steel. Heavy steel castings, plates, plain and flanged are used, as well as rolled steel, angles, channels, etc.

Great Britain.

Until the last few years, the general practice in Great Britain has been to build the carriages with steel underframes and wooden bodies (Classification 1) although some companies, namely, the Great Western Railway and the Southern Railway, have made a practice of constructing carriages with steel floors covered with Decolite, with a view to reducing liability of fire in case of collision, the main body framing being of hard-wood covered with galvanized steel panelling.

Great Western Railway. — As already mentioned in clause 2, have only built one experimental carriage all-steel (Classification 3-B) with steel body framework, outside panelling in steel, but inside partitions and inside panels of wood. This was found considerably heavier and more costly than their standard practice.

London Midland & Scottish Railway. — The semi-steel carriages (Classification 2) used on electric services, are of

the compartment type, the underframe being built up of mild steel channels, rolled sections and plates. The body framing of the motor and switchgear compartments consists of rolled steel angles and plates, whilst that for the luggage and passenger compartments is in wood. The body side and end panelling consists of charcoal-finished, galvanized steel sheets 0.064 inch thick, and roof panelling 0.0625 inch thick, the interior finish being in timber. Galvanized corrugated steel sheets covered with Decolite, form the floor, which is 1 1/4 inches thick.

The all-steel carriages (Classification 3-A) running on the electric service in the Manchester District, have the body built directly on to the underframe. The framing is of steel, and aluminium sheets are used for panelling. The doors and mouldings are made up of pressed and drawn steel respectively, and all stock is fitted with end doors.

The all-steel (Classification 3-B) bogie third vestibule carriages and brake vans recently placed in main line services, have the body and underframe combined to form a long tubular girder, of which the top member is the roof of the carriage, and the bottom member is formed by the underframe. The sides of the vehicles are kept as free as possible of doors in such positions as would weaken the structure. The main body framing is composed of pressings and steel sections; the body side and end panelling consists of mild steel plates, charcoal - finished, lead-coated, 0.09375 inch thick, and for the roof, similar plates, 0.080 inch thick, galvanized, are used. There is a special rolled section forming the rain gutter, which acts partly as a cant rail, and connects the body and roof together, as well as supporting the carlines, to which the roof plates are attached. Figures 8 and 9 shew a vestibule third of wood (Classification 1) and all-steel (Classification 3-B) construction respectively. Figures 10 and 11 shew a standard underframe as constructed by the London Midland & Scottish Railway, whilst figures 12, 13, 14 and 15 shew all-steel carriage (Classification 3-B) in various stages of construction.

This Company have also had built a 50-foot passenger brake van with a vitreous enamelled body; a fuller description of the process and materials adopted, appears in clause 4, item *e*, « Panelling and roofing ».

London and North Eastern Railway. — The all-steel carriages (Classification 3-B) (fig. 16) are built to follow general lines of the Company's standard-built timber stock. The kitchen cars are built on a trussed underframe made of standard rolled sections, with body of charcoal-finished, cold-rolled, hydraulically-flattened panel plates. The roof exterior is covered with mild steel plates with cotton duck as an outer covering. The underframes of the open thirds are not trussed, and the main body framing is composed of a series of complete ribs formed by the pillars and carlines, with longitudinal members at waist, cornice and roof, the whole being covered with steel sheeting.

Metropolitan Railway. — The steel underframes of the all-steel carriages (Classification 3-B) are of the built-up type, consisting of rolled sections, no trussbars being used. The body framing consists of steel angles and channels, and the panelling is of steel plates 0.125 inch thick. For the shaped ends of the roof, copper sheets 0.0625 inch thick are used, and the

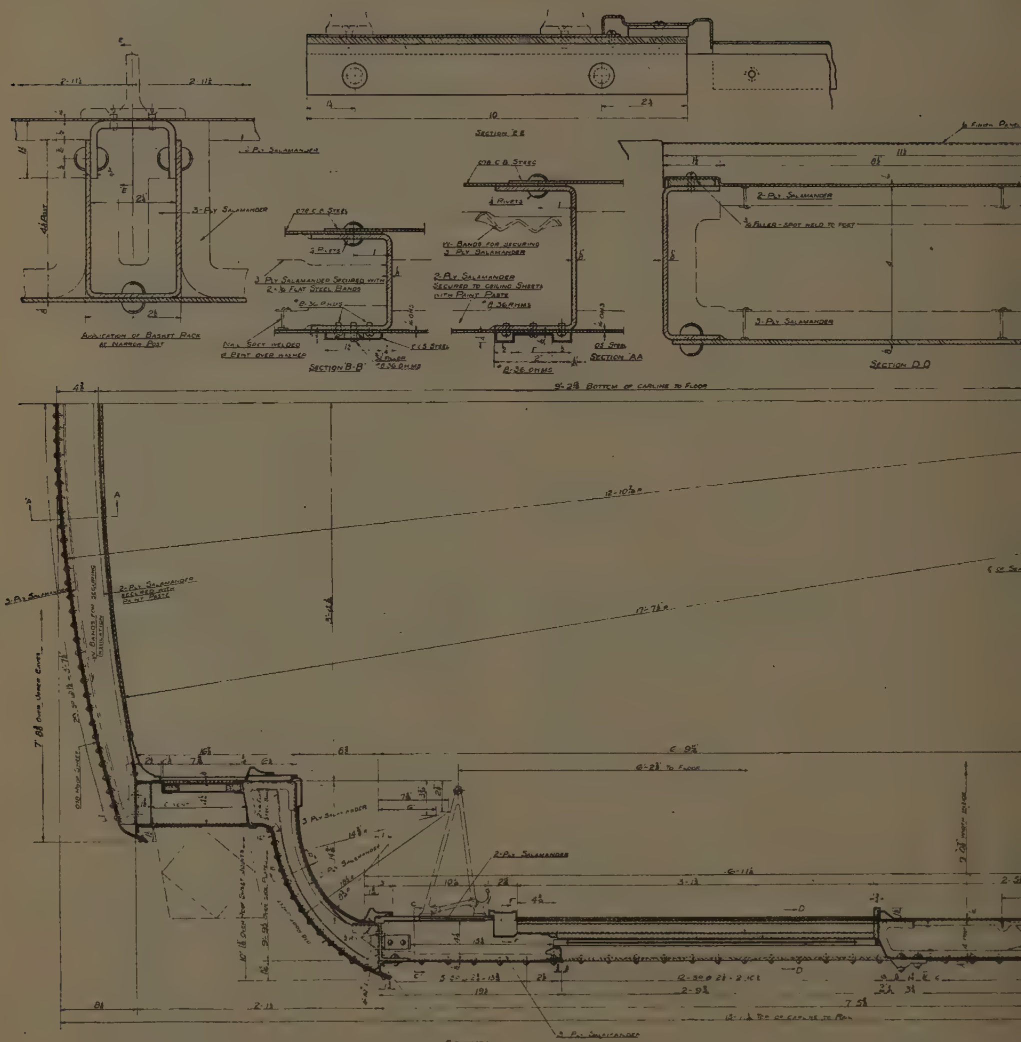
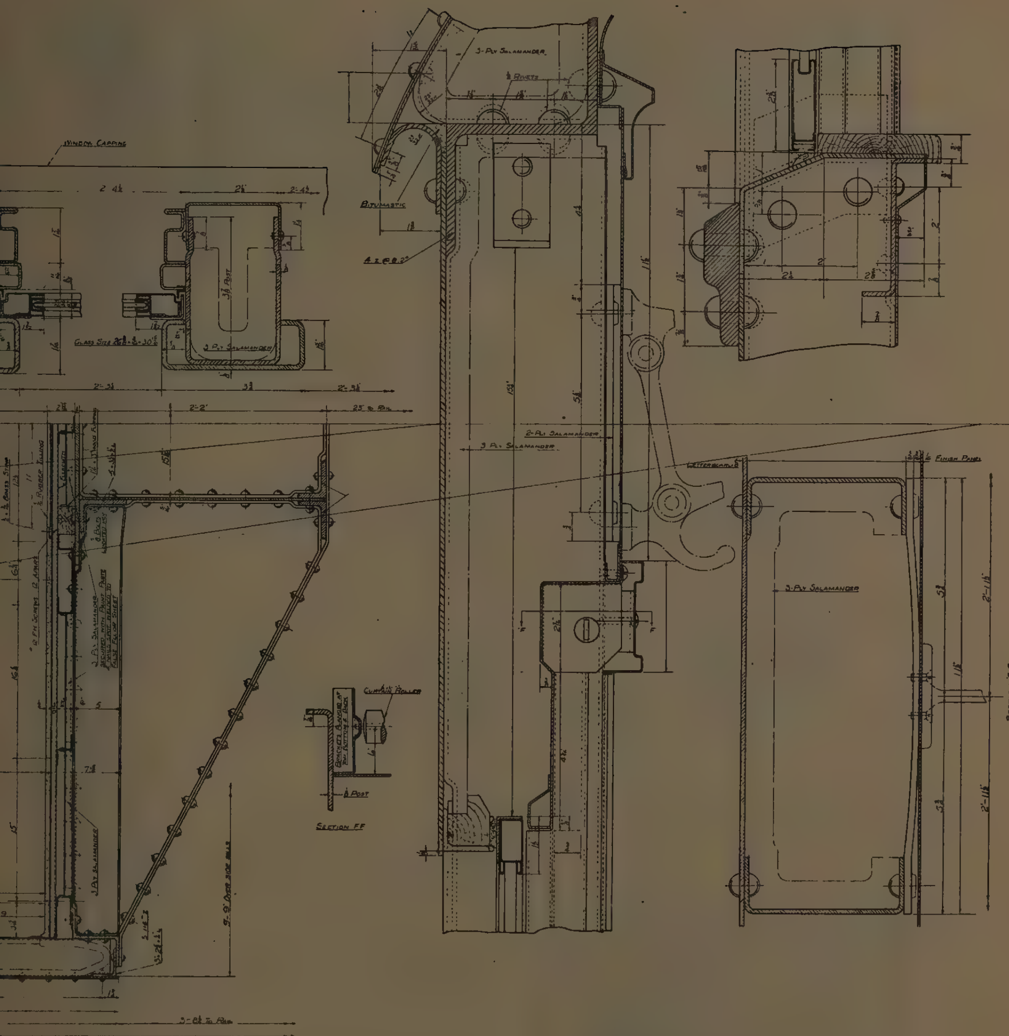


Fig. 3. — Section through body of p



rriages, Baltimore and Ohio Railroad.

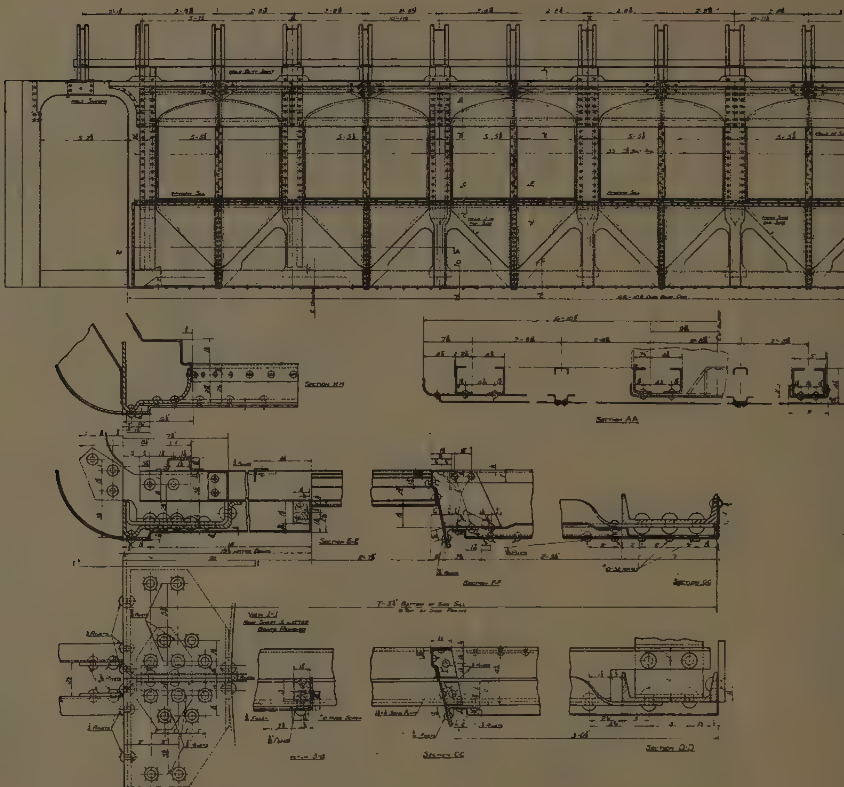


Fig. 4. — Section of bodyside, all-steel carriages, Erie Railroad.

interior furnishing of the carriages is in wood.

Underground Electric Railways Company of London. — Have in traffic, and are building, all-steel carriages (Classification 3-B) with underframe and superstructure as a whole, all fitted with 4-wheel bogies. In their design, the body and underframe are treated as one unit for the purpose of weight-carrying, and this has permitted of lighter sections being used. Profiled steel sheets are riveted to light pressed and rolled steel sections.

Africa.

Gold Coast Government Railway. — The design of the third class all-steel carriages (Classification 3-B) is such as to enable a light body to be used, made up of profiled and shaped steel plates. Lead-coated steel sheets have been used for outside panelling.

Nigerian Railway. — The all-steel carriages (Classification 3-B) on order in England for this Company have steel angles replacing wooden roof sticks, side pillars and bottom sides.

South African Railways and Harbours. — The all-steel carriages (Classification 3-B) in traffic are still considered as being in an experimental stage. The underframe is on the cantilever principle built up chiefly of British standard sections.

Sudan Government Railways and Steamers. — The all-steel carriages (Classification 3-B) have underframes built up of British standard sections, with outside main girder of channels, centre sills of angle and plate, with angle crossbars.

Australasia.

New South Wales Government Railways. — All-steel (Classification 3-A) motor and trailer carriages are in use on electric suburban services, being so designed that the body and underframe may be regarded as one unit for load-carrying purposes, the sides of the body thus carrying part of the load. The body framework is made up of steel pressings and profiled sheet steel plates, with pressed sheet steel ends. Bulkheads are of single plates stiffened with angles.

Canada.

Canadian National Railways. — The all-steel carriages (Classification 3-B) (fig. 17) have continuous self-supporting steel underframes (fish-belly type) to withstand all stresses, and with steel body framing and panelling.

India.

Bombay, Baroda & Central India Railway. — This Company's all-steel stock (Classification 3-B) was built in Great Britain with the body and underframe integral. Steel plates pressed to pattern are used in the construction of these carriages.

Eastern Bengal Railway. — All-steel carriages (Classification 3-B) were obtained in 1919, the general principle underlying the construction being the box formation of underframe and steel body, which gives stability without use of unduly heavy section members.

East Indian Railway. — The all-steel carriages (Classification 3-B) built in 1926 have the built-up type of steel underframe constructed of equal section rolled steel channels. The body framing is built up of rolled and pressed steel members, the latter being used for end and side framing.

Great Indian Peninsula Railway. — All-steel carriages (Classification 3-B) are built on the lines of the wooden-bodied stock, *i. e.*, substantial underframe with superimposed steel framing and panelling. Certain suburban stock has been built on a strengthened underframe more from the point of view of replacing the standard trussing, than that of lightening the body (fig. 18).

North Western Railway of India. — The all-steel carriages (Classification 3-B) have underframes of usual rolled channel sections with cross bracings.

South Indian Railway. — The all-steel carriages (Classification 3-B) recently introduced, have underframes of a stronger pattern, built up of steel curb angle side sills, and stronger section channel iron inner longitudinals and braced angle iron truss stays, secured by angle iron knees and gussets. The body framing is of pressed channel shaped steel pillars

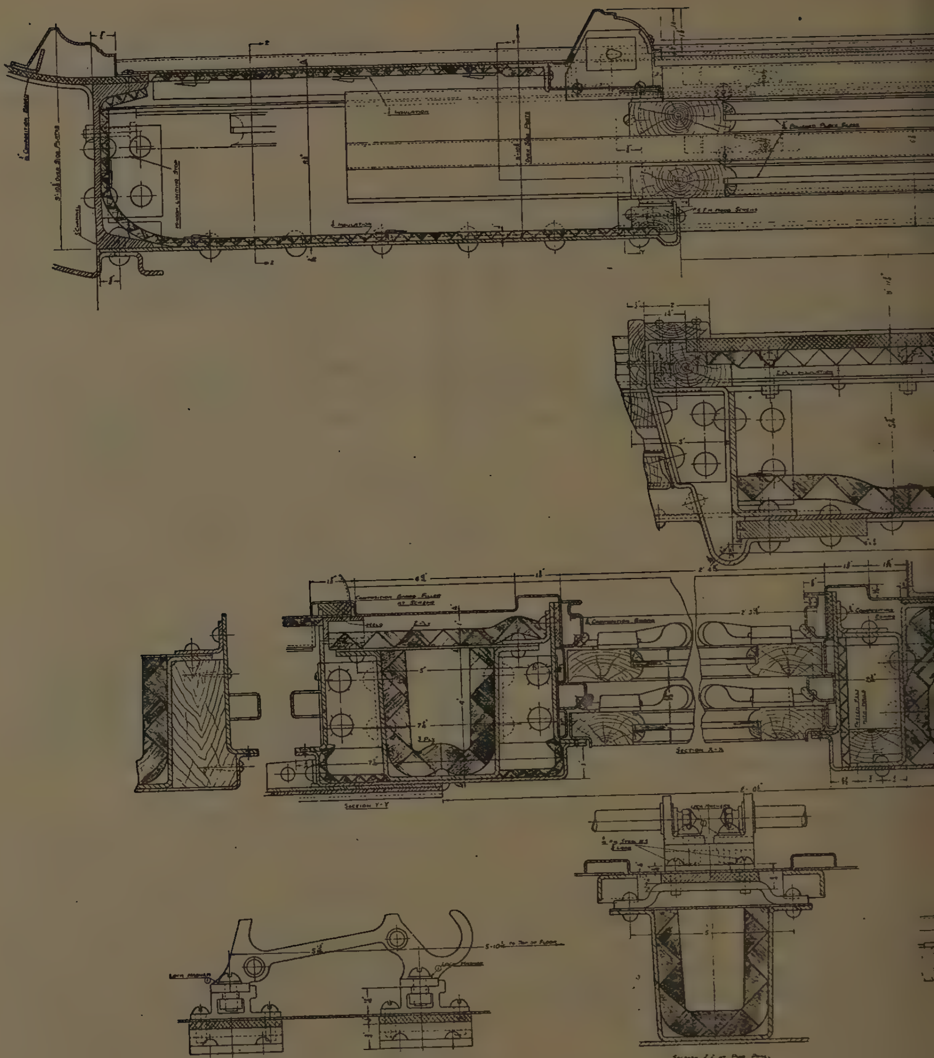
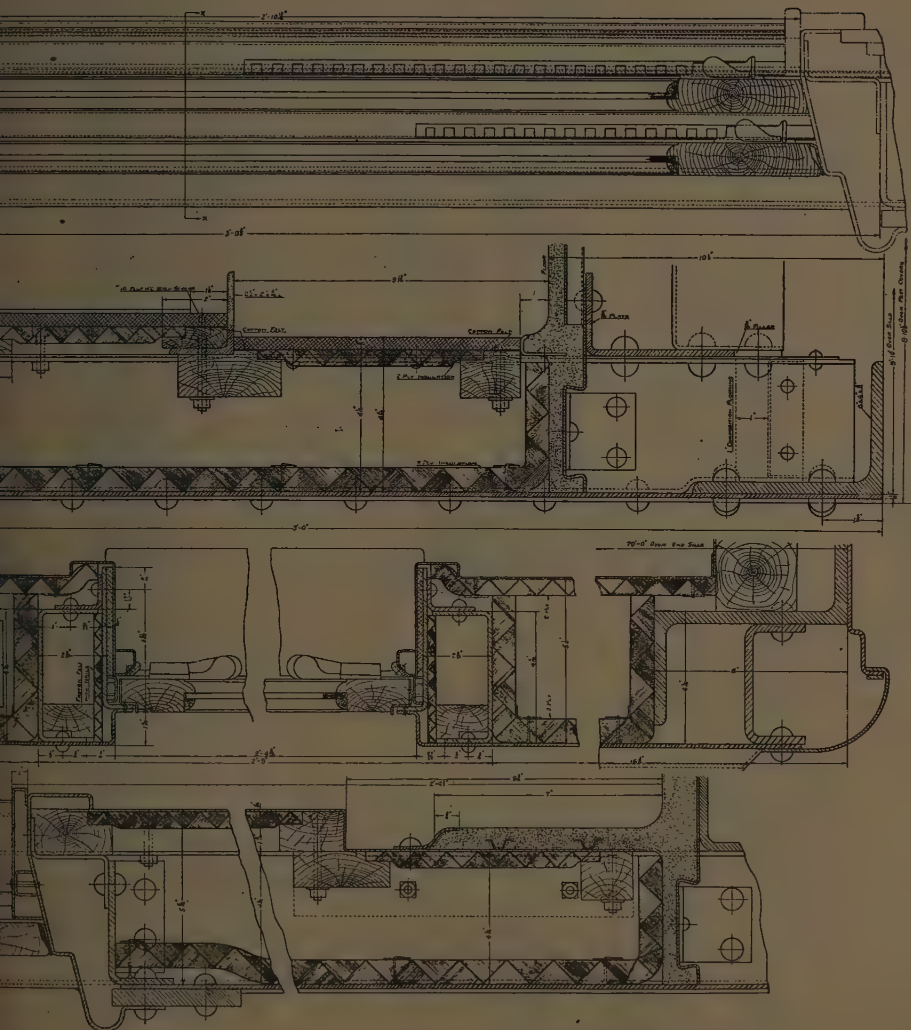


Fig. 5. — Bodyside sec



York Central Railroad.

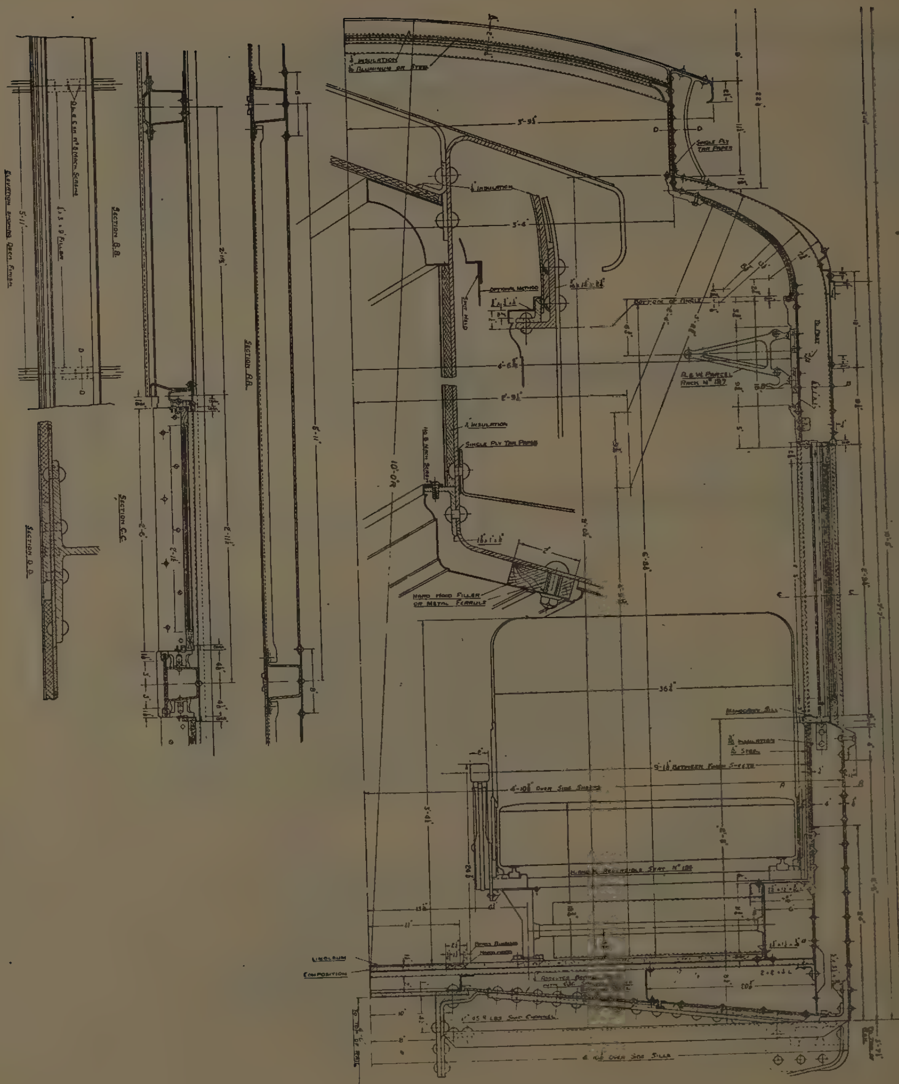


Fig. 6. — Vertical cross section of carriage, Pennsylvania Railroad.

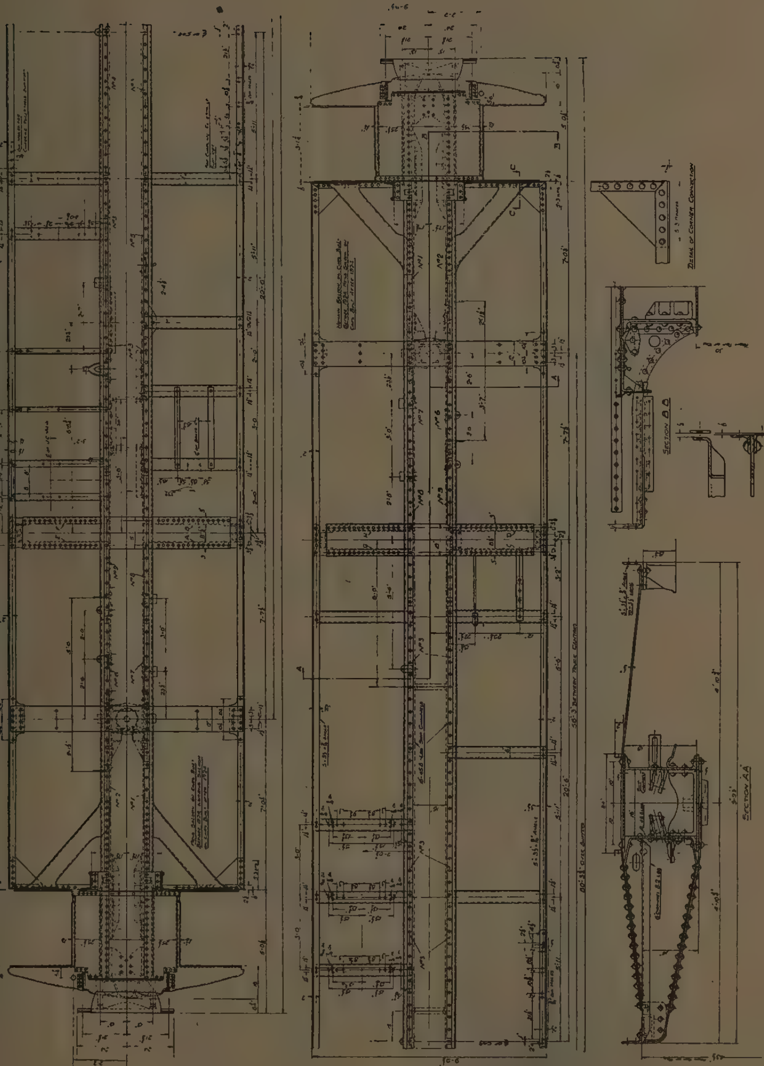


Fig. 7. — Carriage underframe, Pennsylvania Railroad.

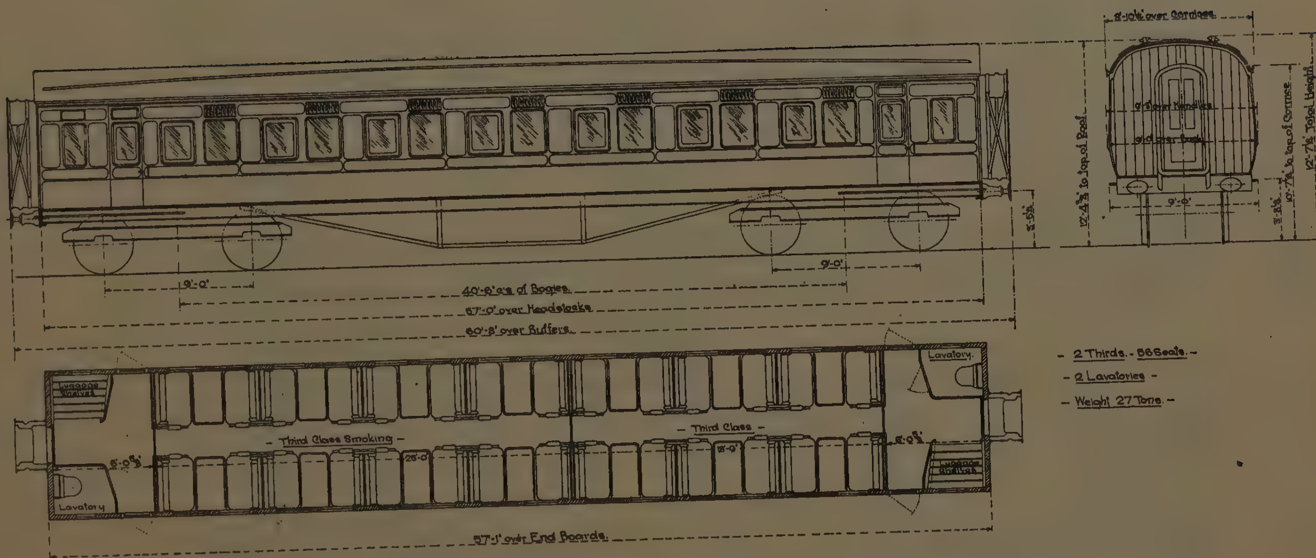


Fig. 8. — Third class vestibule carriage (Classification 1), London Midland & Scottish Railway.

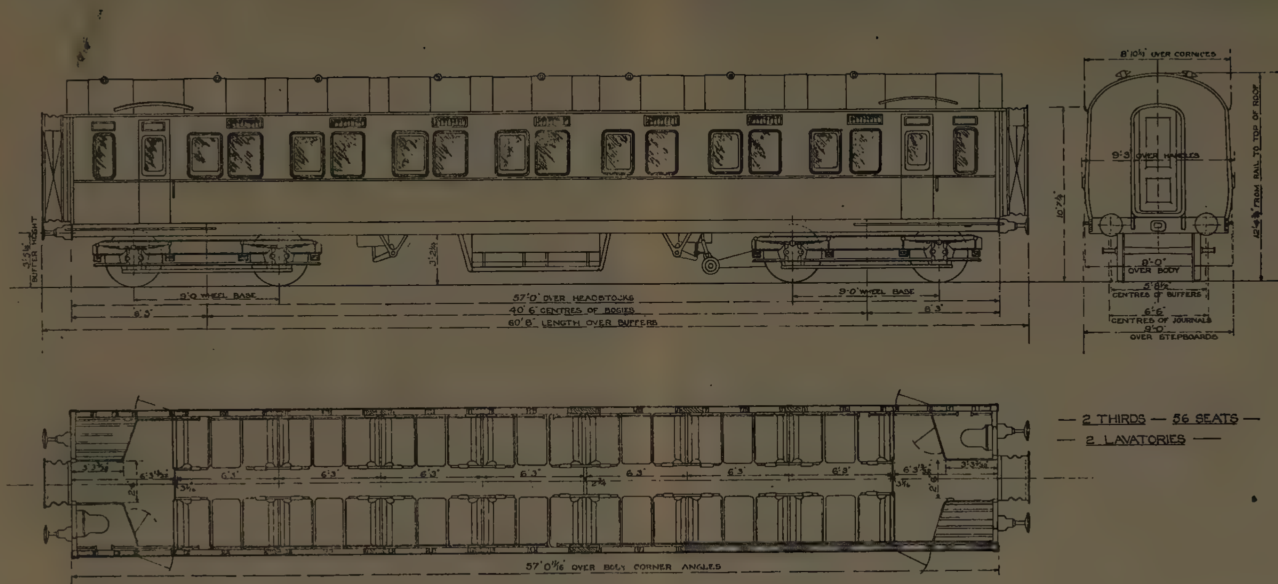


Fig. 9. — Third class vestibule all-steel carriage (Classification 3-B), London Midland & Scottish Railway.

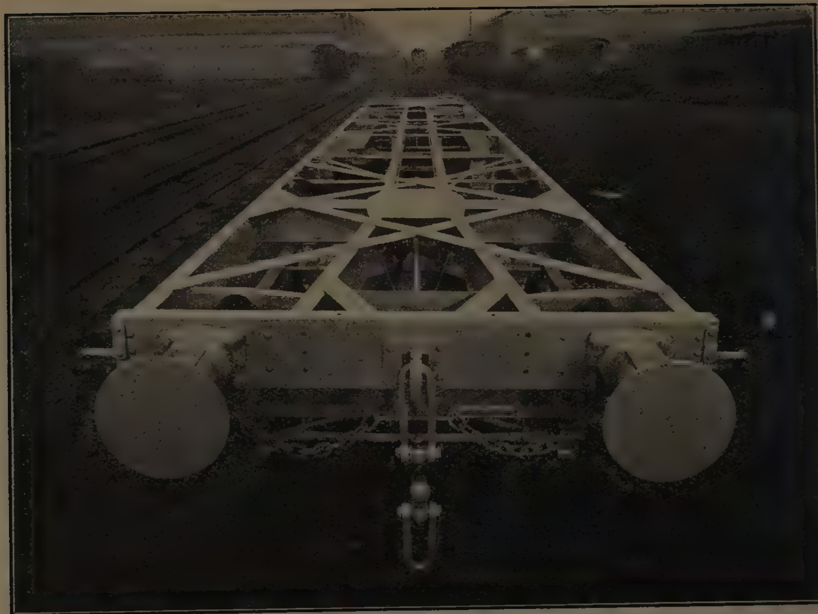


Fig. 10.

Fig. 11.

Figs. 10 and 11. — Standard carriage underframe construction, London Midland & Scottish Railway.

Figs. 12 to 15. — All-steel carriage (Classification 3-B) in various stages of construction, London Midland & Scottish Railway

Fig. 12

Fig. 13.

Figs. 12 to 15. — All-steel carriage (Classification 3-B) in various stages of construction, London Midland & Scottish Railway (*continued*).

Fig. 14.

Fig. 15.

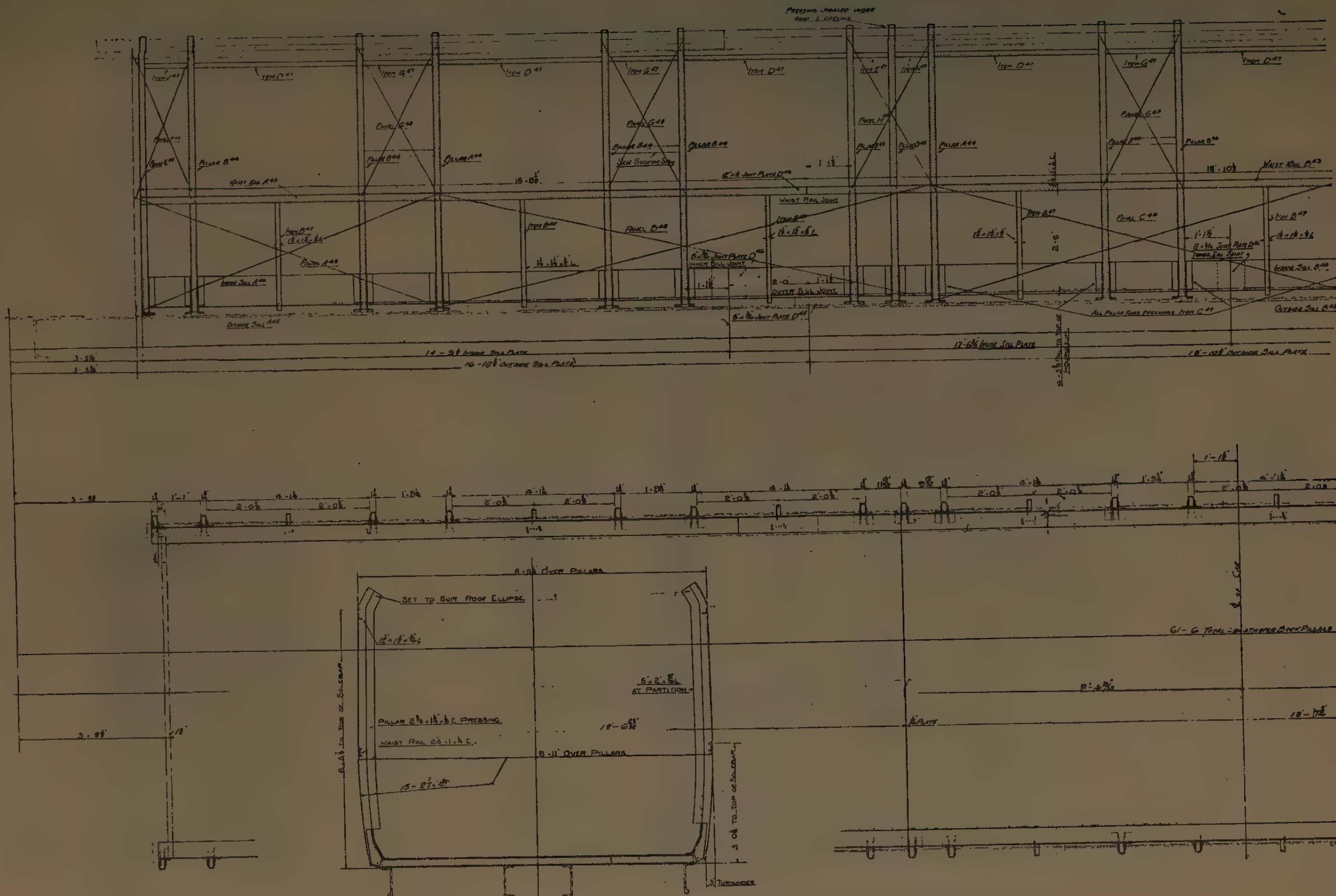


Fig. 16. — All-steel open Third carriage (Classification 3-B), London & North Eastern Railway.

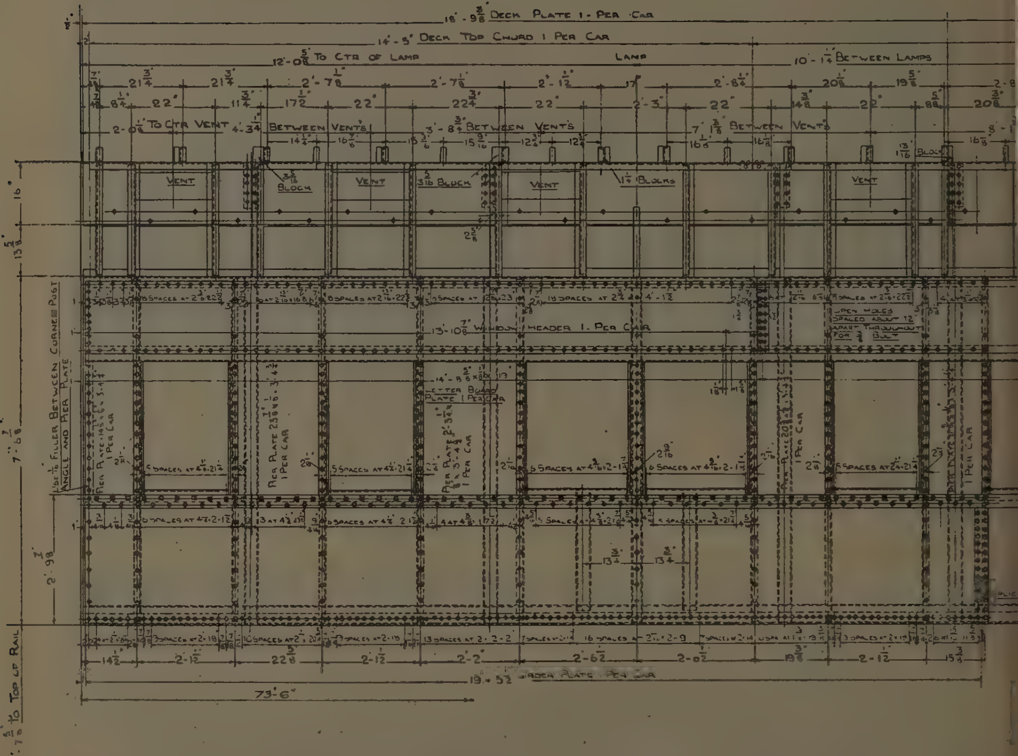


Fig. 17. — Side framing, passenger

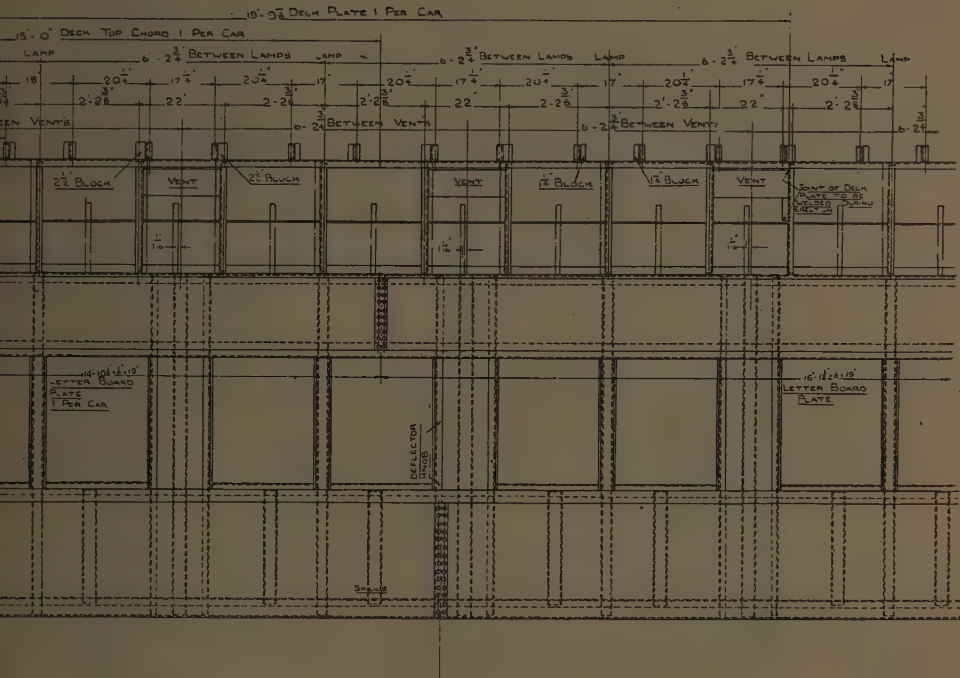
riveted to curb sill at bottom, and « T » and « L » section cant rails at the top. Steel sheets are used for waist and quarter panels riveted to pillars.

Malay States.

There are no steel carriages in use.

Japan.

Government Railways. — The all-steel carriages (Classification 3-B) prior to the present design (fig. 19) had the heavier type of underframe with fish-belly type centre sills, but in the latest design, the channel centre sills are of a lighter type,



ages, Canadian National Railways.

the vertical load being carried by the side framing. The crossbearers and body pillars are of pressed steel.

b) **Underframe.**

The illustrations (fig. 20 [1-17]) shew the principal methods adopted for underframe construction which have been abstracted from the drawings supplied by various railway companies who have replied to the Questionnaire.

An analysis of the methods adopted shews that the centre sill type is the most usual type used, and the probable reason

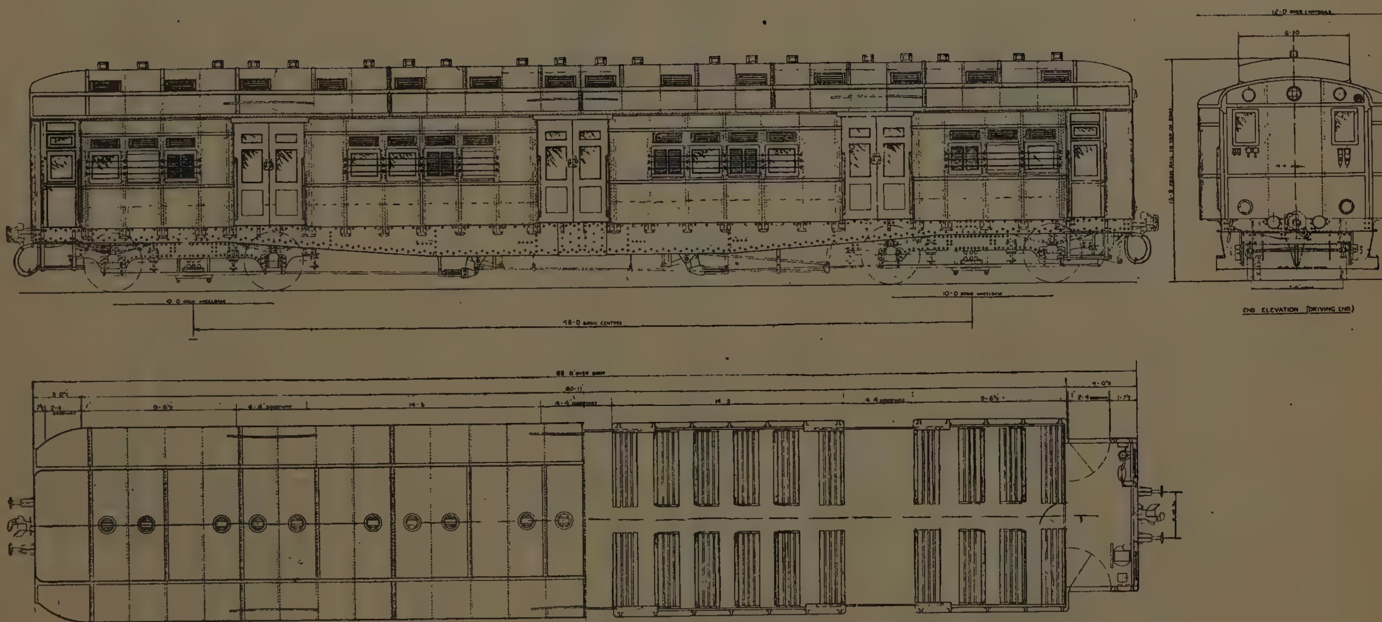


Fig. 18. — Third class trailer. General arrangement. Great Indian Peninsula Railway.

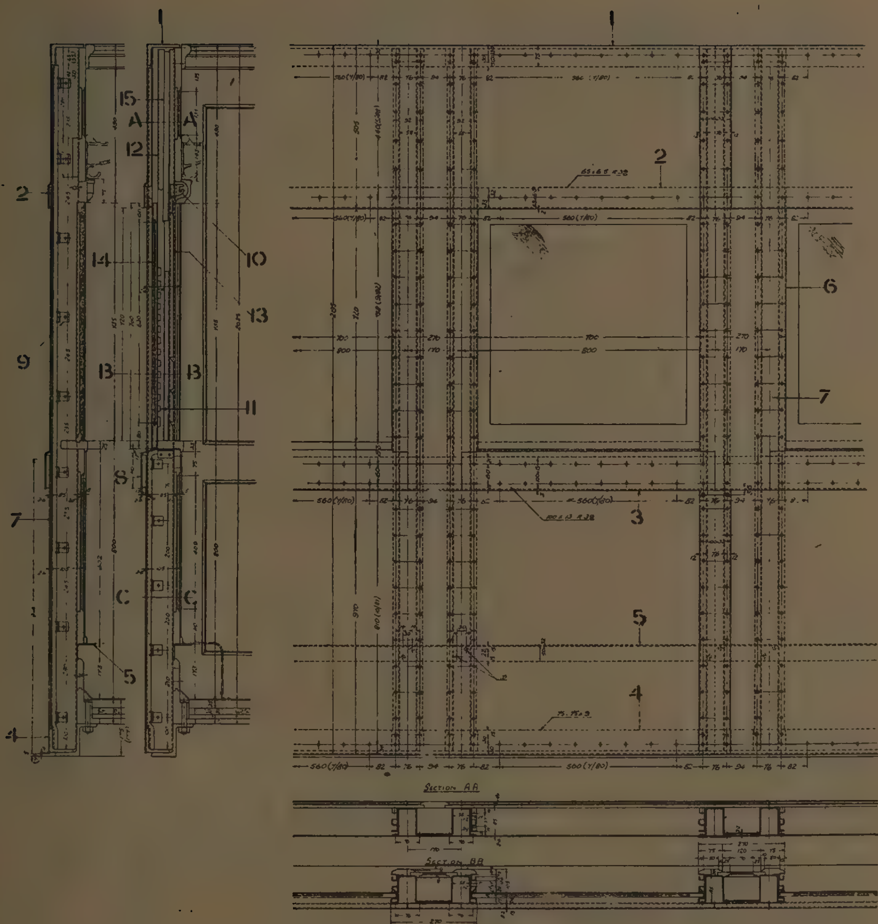


Fig. 19. — Section and elevation of second class day coach (side framing), Japanese Government Railways.

for this has arisen from the fact that in the United States of America, where the largest number of steel carriages are in use, centre draw and buffing gear was the standard practice, and it was therefore necessary to have a strong centre girder with cross members fixed as cantilevers on which the body was built.

In Japan, an examination of the drawings shews that the earliest types were constructed more on the lines of American practice, but later designs have been modified as illustrated in figure 19.

In Great Britain, the design of underframe has generally followed that in use with wooden bodies, except that the use of steel bodies has enabled the members to be lightened and the truss rods done away with, in view of the fact that the body forms part of the beam supporting which are the bogie centres. The reason for following on these lines is that the largest proportion of carriages in Great Britain are fitted with side buffers, and this type of buffing gear has very largely decided the design of the underframe.

c) Flooring.

The method found generally satisfactory in various countries has been to construct the floor of dovetailed or corrugated galvanized steel sheeting riveted to the underframe. This sheeting varies in thickness from 0.028 inch to 0.036 inch and should be treated with Bitumastic paint before being covered with fireproof material, as with the solution used in mixing the various fireproof compositions, there is a tendency for corrosion of steel floors to take place, which is often not discovered until the corrosion has gone right through.

Various compositions such as « Flexolith » and « Decolite » are used, 0.375 inch or 0.5 inch thick, and figure 21 (1-15) illustrates various types op flooring and covering adopted in the different countries for semi-steel and all-steel carriages.

There is no doubt that this method of forming the floor and riveting it to the underframe, considerably adds to the strength of the vehicle, and it is noticeable that in a collision, this flooring tends to hold the underframe members together. Most of the fireproof compositions used for covering the floors have the advantage of being more hygienic than wooden floors, are cleaned more easily, and are not so cold to the passengers' feet.

d) Main body framing.

An analysis of the drawings shews that a very large proportion of the main body framing is made up of pressings, and examples of these are shewn in figure 22 (1-12). The great advantage of the pressing is that it is light in weight, combined with stiffness, and can be formed into the most suitable shapes for ease of attachment of the interior furnishings.

Figure 23 (1-23) shews principal methods of roofstick and cant rail. The principal designs shew that these have been made with a view to ease of construction, so that the roofs can be built on jigs and dropped into position when the body sides are erected.

Various designs of waist rails have also been extracted from the drawings received, and these are illustrated by figure 24 (1-16).

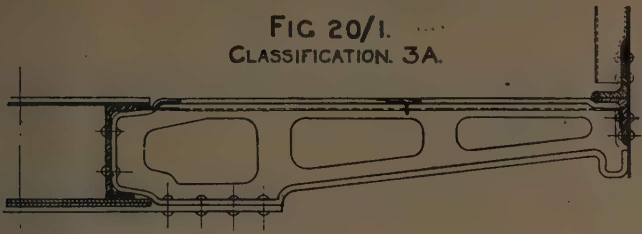
Figure 25 illustrates in detail the steel framing of an all-steel carriage (Classification 3-B) on the London Midland & Scottish Railway, England.

e) Panelling and roofing.

A variety of practice exists. In some cases, lead-coated and galvanized panels are used, or black sheets as received from the factory. Panels made of aluminium have been successfully tested on all-metal carriages on the *London Midland & Scottish Railway, England (Manchester Electric Lines)*.

Copper bearing steel sheets are also

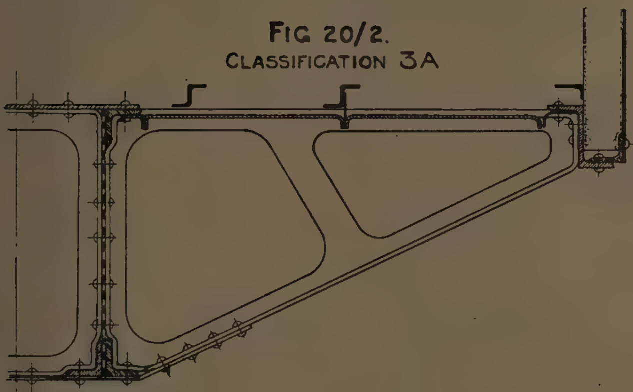
Figs. 20/1 to 20/17. — Types of underframes. All-steel carriages (Classification 3 [A and B]).



U. S A.

Long Island Railroad.

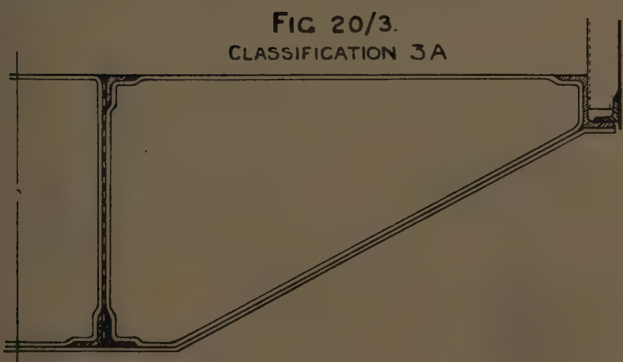
Rolled steel centre sill and side sill angle. Steel panel. Insulation to outside panel.



U. S. A.

Erie Railroad.

Plate web and three angle centre sill. Rolled steel side sill. Steel panel.



U. S. A.

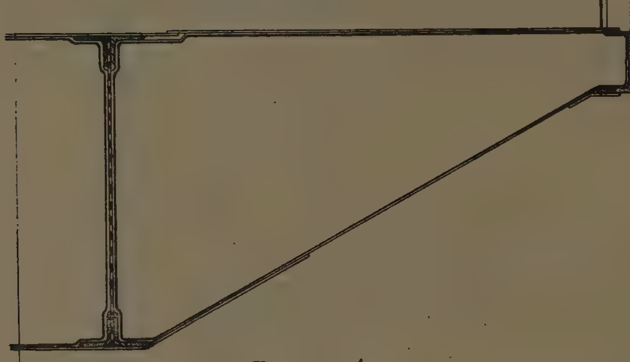
Lehigh Valley Railroad.

Plate web and three angle centre sill and rolled steel zed and angle side sill. Steel panel.

Figs. 20/1 to 20/3.

Figs. 20/1 to 20/17. — Types of underframes (*continued*).

FIG 20/4.
CLASSIFICATION 3A

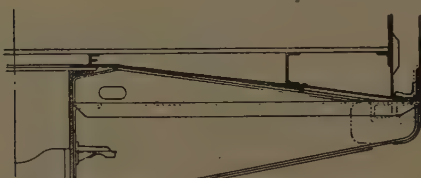


U. S. A.

Reading Company.

Plate web and four angle centre sill and two angle side sill. Steel panel.

FIG 20/5.
CLASSIFICATION 3 A.

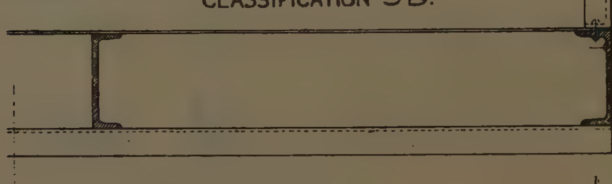


U. S. A. (3-A).

Pennsylvania Railroad System.

Rolled steel centre sill and inverted side sill angle. Steel panel.

FIG 20/6A.
CLASSIFICATION 3 B.

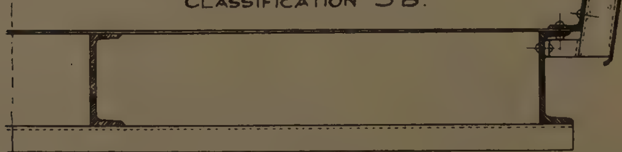


BRITISH (3-B).

Underground Electric Railways Company of London.

Rolled steel centre and side sill. Steel panel and mould.

FIG 20/6B
CLASSIFICATION 3 B.



AFRICA (3-B).

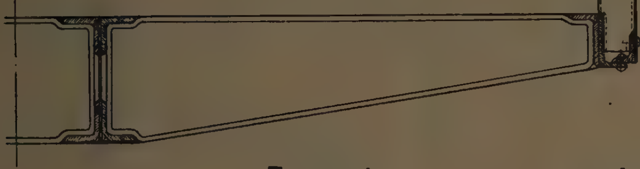
Nigerian Railway.

Rolled steel centre and side sill. Steel panel.

Figs. 20/4 to 20/6-B.

Figs. 20/1 to 20/17. — Types of underframes (*continued*).

FIG 20/7.
CLASSIFICATION 3B



CHINA.

South Manchuria Railway.

Plate web and four angle centre sill and three angle side sill. Steel plate insulation to outside panel.

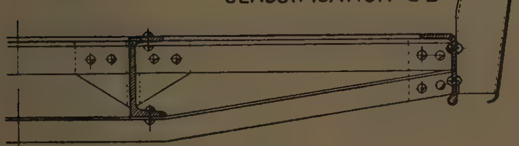
FIG 20/8.
CLASSIFICATION 3B

U. S. A.

Richmond, Fredericksburg and Potomac Railroad.

Plate web and three angle centre sill and rolled steel angle side sill. Steel plate insulation to outside panel.

FIG 20/9.
CLASSIFICATION 3B

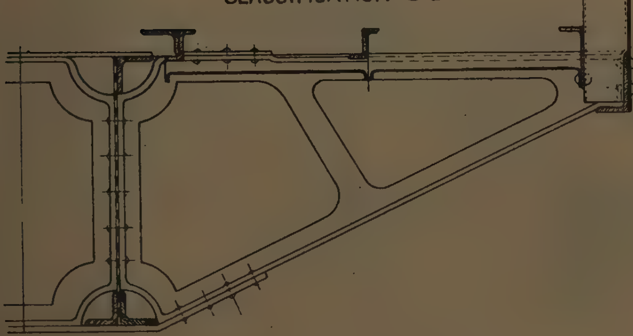


INDIA.

South Indian Railway.

Rolled steel centre sill and bulb angle side sill. Steel panel.

FIG 20/10.
CLASSIFICATION 3B



U. S. A.

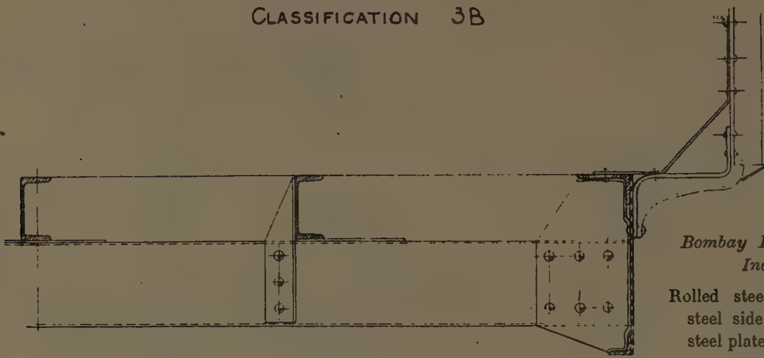
New York Central Railroad.

Plate web and three angle centre sill. Rolled steel angle side sill (flanges inward). Steel panel. Insulation to inside and outside panels.

Figs. 20/7 to 20/10.

Figs. 20/1 to 20/17. — Types of underframes (*continued*).

FIG 20/11.
CLASSIFICATION 3B



INDIA.

Bombay Baroda and Central India Railway.

Rolled steel centre sill. Rolled steel side sill, with girder type steel plate. Steel panel.

FIG 20/12.
CLASSIFICATION 3B

AFRICA.

South African Railways and Harbours.

Pressed steel centre sill, rolled steel angle side sill. Steel mould and panel.

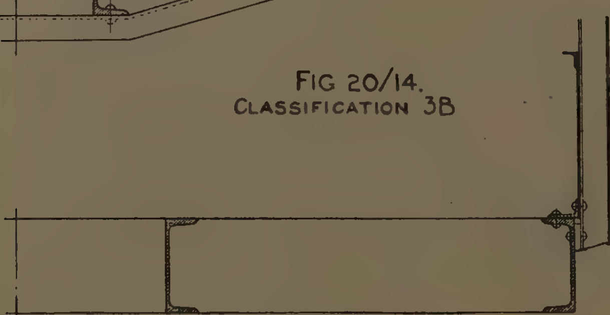
FIG 20/13.
CLASSIFICATION 3B

AFRICA.

South African Railways and Harbours.

Rolled steel centre sill, tee side sill.

FIG 20/14.
CLASSIFICATION 3B



INDIA.

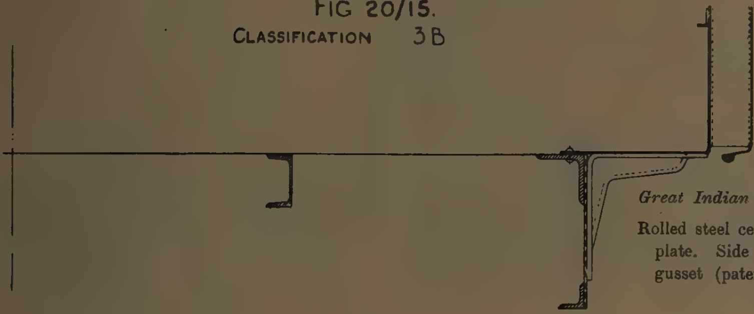
Eastern Bengal Railway (State Railway of India).

Rolled steel centre and side sill with angle plate gusset (patent). Steel mould and panel.

Figs. 20/11 to 20/14.

Figs. 20/1 to 20/17. — Types of underframes (*continued*)

FIG 20/15.
CLASSIFICATION 3B

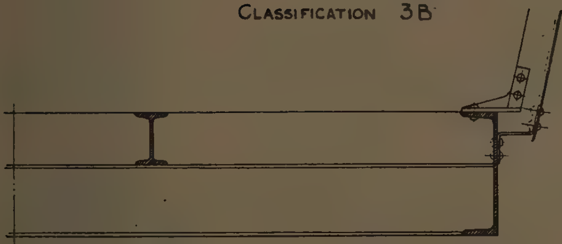


INDIA.

Great Indian Peninsula Railway.

Rolled steel centre sill and angle and plate. Side sill with pressed steel gusset (patent). Steel panel.

FIG 20/16.
CLASSIFICATION 3B

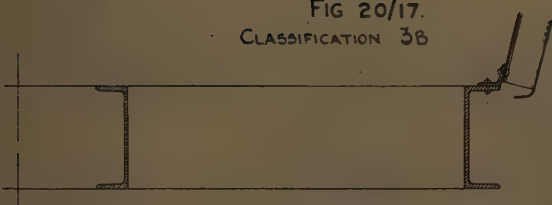


BRITISH.

London Midland and Scottish Railway.

Rolled steel section solebar and longitudinal, and pressed steel zed side sill. Steel panel.

FIG 20/17.
CLASSIFICATION 3B



BRITISH.

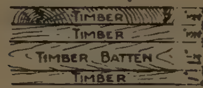
London Midland and Scottish Railway.

Rolled steel section solebar and longitudinal, and angle side sill. Steel panel.

Figs. 20/15 to 20/17.

Figs. 21/1 to 21/15. — Types of flooring and covering. Semi-steel ([Classification 2] and all-steel [Classification 3-A and 3-B]).

FIG 21/1.



ARGENTINE.
STATE RAILWAYS.
TWO THICKNESSES OF BOARDS ON CARRIAGE FLOOR BEARER & ONE UNDERNEATH.

ALL STEEL (CLASSIFICATION 3(A&B)

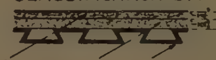
FIG 21/2.
CLASSIFICATION 3A

_U.S.A._
READING COMPANY.
CHANARCH COVERED WITH FLEXOLITH

FIG 21/3.
CLASSIFICATION 3A

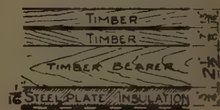
_U.S.A._
RICHMOND FREDERICKSBURG & POTOMAC RAILROAD.
BUILT UP FLOOR OF COPPER BEARING STEEL. INSULATION, GALVANISED PRESSED FLOOR PLATES COVERED WITH FLEXOLITH.

FIG 21/4.
CLASSIFICATION 3A



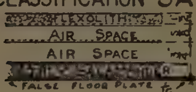
AUSTRALASIA.
NEW SOUTH WALES GOVERNMENT RLY.
KEYSTONE STEEL SHEETING. CORK, & LINOLEUM.

FIG 21/5.
CLASSIFICATION 3A



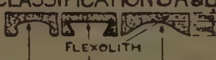
_U.S.A._
RICHMOND FREDERICKSBURG & POTOMAC RAILROAD.
STEEL PLATE, INSULATION, SPACE FOR BEARER, DOUBLE BOARDS INTERLEAVED WITH NEPONSIT PAPER

FIG 21/6.
CLASSIFICATION 3A



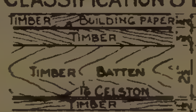
_U.S.A._
BALTIMORE & OHIO RAILWAY.
FLEXOLITH ON STEEL SHEET. AIR SPACE. 3 PLY SALAMANDER SECURED WITH PAINT PASTE & NAILS SPOT WELDED TO FALSE FLOOR SHEET

FIG 21/7.
CLASSIFICATION 3A&B



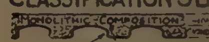
BRITISH.
LONDON MIDLAND & SCOTTISH RAILWAY.
CHANARCH, KEYSTONE OR CORRUGATED SHEET STEEL, COVERED WITH FLEXOLITH OR OTHER COMPOSITION

FIG 21/8.
CLASSIFICATION 3B



CHINA.
SOUTH MANCHURIAN RLY.
DOUBLE FLOOR WITH BUILDING PAPER INTERLEAVED, & CELSTON UNDERNEATH FLOOR BEARER.

FIG 21/9.
CLASSIFICATION 3B



_U.S.A._
NEW YORK CENTRAL RAILROAD.
CHANARCH, CORRUGATED, OR OTHER SHEET STEEL COVERED WITH MONOLITHIC COMPOSITION, WITH METAL FALSE FLOOR FULLY INSULATED BELOW MAIN FLOOR.

FIG 21/10.
CLASSIFICATION 3B

BRITISH.
UNDERGROUND ELECTRIC RAILWAYS. LONDON.
STEEL PLATE. LAYER OF ASBESTOS BETWEEN WOOD SLATS, & PLATE

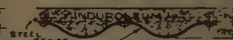
FIG 21/11.
CLASSIFICATION 3B

INDIA.
EASTERN BENGAL RLY. STATE RAILWAY.
FLANGED OR DOVETAILED SHEET STEEL COVERED WITH DECOLITE, OR OTHER COMPOSITION.

FIG 21/12.
CLASSIFICATION 3B

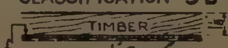
JAPAN.
GOVERNMENT RAILWAY.
DOUBLE FLOOR CONSISTING OF TWO DIFFERENT THICKNESSES OF BOARDS, INTERLEAVED WITH INSULATING MATERIAL.

FIG 21/13.
CLASSIFICATION 3B



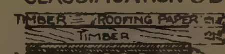
BRITISH.
LONDON MIDLAND & SCOTTISH RLY.
CORRUGATED STEEL SHEETING COVERED WITH INDUROLEUM.

FIG 21/14
CLASSIFICATION 3B



AFRICA.
SOUTH AFRICAN RLY & HARBOURS.
FLOOR PLATE, BITUMEN, & FLOOR BOARDS.

FIG 21/15.
CLASSIFICATION 3B



CANADA.
CANADIAN NATIONAL RAILWAYS.
STEEL SHEET TWO LAYERS OF SALAMANDER ROOFING PAPER DOUBLE BOARDS INTERLEAVED WITH ROOFING PAPER.

Figs 22/1 to 22/12. — Details of main body framing pillars. All-steel carriages (Classification 3-A and 3-B).

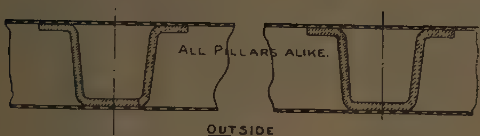
FIG 22/1.

CLASSIFICATION 3-A.

U. S. A. — *Long Island Railroad.*
Pennsylvania Railroad.

Built up of light pressed steel channel (with flanges) and steel plate. Steel outer and inner panels.

FIG 22/2.

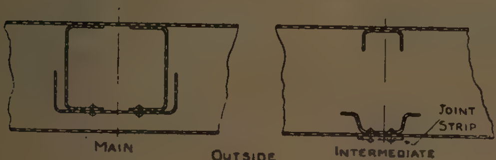


CLASSIFICATION 3-A.

U. S. A. — *Erie Railroad.*

Pressed steel channel (with flanges). Steel outer and inner panels.

FIG 22/3.

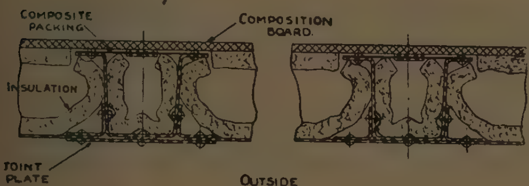


CLASSIFICATION 3-A.

U. S. A. — *Erie Railroad.*

Pressed steel pillars with steel outer and inner panels.

FIG 22/4.

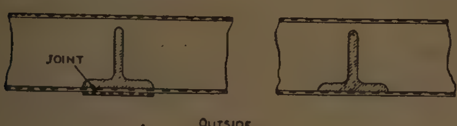


CLASSIFICATION 3-A.

U. S. A. — *New York Central Railroad.*

Built of pressed steel channel (with flanges). Pressed steel angles and plates. Steel panels outside and composition panels inside. Insulation used between outer and inner panels.

FIG 22/5.

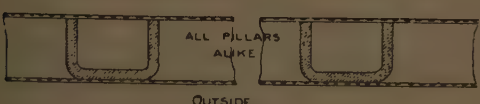


CLASSIFICATION 3-A.

U. S. A. — *Norfolk and Western Railroad.*

Rolled steel tee with steel outer and inner panels.

FIG 22/6.



CLASSIFICATION 3-A.

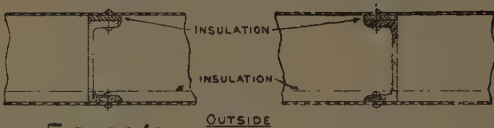
U. S. A. — *Norfolk and Western Railroad.*
Reading Company.

Pressed steel channel (heavy section) with steel outer and inner panels.

Figs. 22/1 to 22/6.

Figs. 22/1 to 22/12. — Details of main body framing pillars (*continued*).

FIG 22/7.

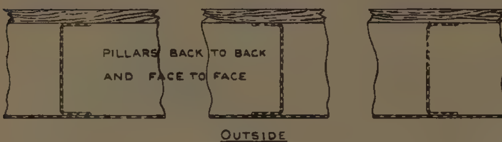


CLASSIFICATION 3-A.

U. S. A. — *Richmond Fredericksburg and Potomac Railroad.*

Rolled steel channel, steel outer panels and steel inner panels insulated from framing.

FIG 22/8.



CLASSIFICATION 3-B.

CHINA. — *South Manchuria Railway.*

AFRICA. — *Nigerian Railway.*
South African Railway and Harbours.

BRITISH. — *Underground Electric Railways Company of London.*

Light pressed steel channel with steel outer and timber inner panels.

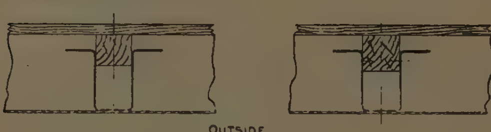
FIG 22/9.

CLASSIFICATION 3-B.

BRITISH — *Underground Electric Railways Company of London.*

Rolled steel angle with timber packing. Steel outer and inner panels.

FIG 22/10.



CLASSIFICATION 3-B.

BRITISH. — *London Midland and Scottish Railway.*

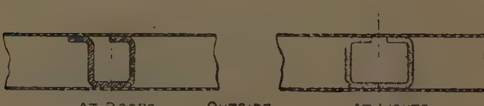
AFRICA. — *South African Railways and Harbours.*

INDIA. — *Bombay, Baroda and Central India Railway.*
Eastern Bengal Railway.
East Indian Railway.
Great Indian Peninsula Railway.

JAPAN. — *Japanese Government Railways.*

Pressed steel channel with flanges. Steel outer and timber inner panels.

FIG 22/11.



CLASSIFICATION 3-B.

AFRICA. — *South African Railways and Harbours.*

Pressed steel channels with flanges turned outwards or inwards to suit construction. Steel outer and inner panels. (Timber doors and floors, etc.)

FIG 22/12.

CLASSIFICATION 3-B.

INDIA. — *South Indian Railway.*

Pressed steel channel with timber packing.

Steel outer and inner panels.

Figs. 22/7 to 22/12.

Figs. 23/1 to 23/23. -- Details of roof stick and cant rail. All-steel carriages (Classification 3-A and 3-B).

FIG 23/1.
CLASSIFICATION 3A.

U.S.A. READING COMPANY.
BUILT UP BODY SIDE, PILLAR, AND ROOFSTICK ANGLE CANT RAIL.

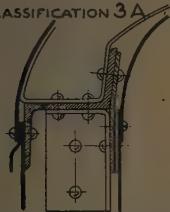
FIG 23/2.
CLASSIFICATION 3A.

BRITISH. LONDON MIDLAND & SCOTTISH RLY.
COMBINED BODY SIDE PILLAR AND ROOFSTICK WITH JOINT IN CENTRE OF ROOF. NOTCHED ANGLE CANT RAIL.

FIG 23/3.
CLASSIFICATION 3A.

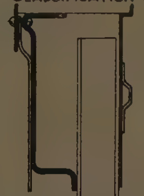
U.S.A. LEHIGH VALLEY RAILROAD.
BUILT UP BODY SIDE PILLAR AND ROOFSTICK CHANNEL CANT RAIL.

FIG 23/4.
CLASSIFICATION 3A.



U.S.A. RICHMOND FREDERICKSBURG AND POTOMAC RAILROAD.
BUILT UP BODY SIDE PILLAR AND ROOFSTICK. ZED CANT RAIL

FIG 23/5.
CLASSIFICATION 3A.



U.S.A. ERIE RAILROAD.
BUILT UP BODY SIDE PILLAR AND ROOFSTICK. PRESSED STEEL CANT RAIL

FIG 23/6.
CLASSIFICATION 3A

U.S.A. LONG ISLAND RAILROAD.
BUILT UP BODY SIDE PILLAR AND ROOFSTICK PRESSED STEEL WEDGE SHAPE CANT RAIL.

FIG 23/7.
CLASSIFICATION. 3A

U.S.A. NORFOLK AND WESTERN
BUILT UP BODY SIDE PILLAR AND ROOFSTICK. TWO ANGLE CANT RAILS.

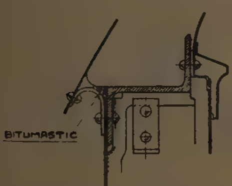
FIG 23/8.
CLASSIFICATION. 3A.

U.S.A. PENNSYLVANIA RAILROAD SYSTEM
PRESSED STEEL COMBINED BODY SIDE, PILLAR AND ROOFSTICK. ANGLE CANT RAIL AND PRESSED STEEL ROOF SHEET DISTANCE PIECE.

FIG 23/9.
CLASSIFICATION 3A.

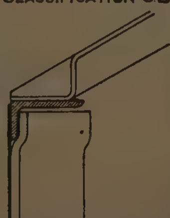
U.S.A. WABASH RAILWAY.
ANGLE CANT RAIL AND PRESSED STEEL ROOF SHEET DISTANCE PIECE AND GUTTER.

FIG 23/10.
CLASSIFICATION 3A



U.S.A. BALTIMORE AND OHIO RAILROAD.
SEPARATE BUILT UP BODY SIDE & ROOF UNITS PRESSED STEEL BODY SIDE PILLAR AND ROOFSTICK, ROLLED STEEL ZED CANT RAIL WITH PRESSED STEEL DISTANCE PIECE TO OUTSIDE ROOF PANEL

FIG 23/11.
CLASSIFICATION 3B.



JAPAN. GOVERNMENT RAILWAY.
BUILT UP BODY SIDE PILLAR & ROOFSTICK ANGLE CANT RAIL

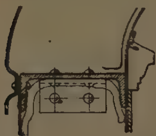
FIG 23/12.
CLASSIFICATION 3.B.

AFRICA SOUTH AFRICAN RLY & HARBOURS
INDIA EASTERN BENGAL RLY. (STATE RLY).
SEPARATE BODY SIDE AND ROOF UNITS TWO ANGLE CANT RAIL.

Figs. 23/1 to 23/12.

Figs. 23/13 to 23/23. — Details of roof stick and cant rail (*continued*).

FIG 23/13.
CLASSIFICATION 3.B.

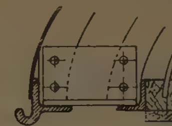


U.S.A. NEW YORK CENTRAL RAILROAD.
BUILT UP BODY SIDE PILLAR AND ROOFSTICK. CHANNEL CANT RAIL WITH PRESSED DISTANCE PIECE TO ROOF SHEETING.

FIG 23/14.
CLASSIFICATION 3B

BRITISH. LONDON MIDLAND & SCOTTISH RLY.
BUILT UP BODY SIDE, PILLAR AND ROOFSTICK. ANGLE CANT RAIL AND PRESSED STEEL GUTTER CORNICE.

FIG 23/15.
CLASSIFICATION 3.B.

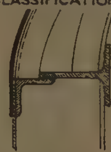


INDIA. BOMBAY BARODA, CENTRAL INDIA RLY
SEPARATE BODY SIDE AND ROOF UNIT WITH ANGLE AND SPECIAL TEE SECTION CANT RAILS.

FIG 23/16.
CLASSIFICATION. 3.B.

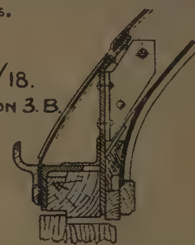
INDIA. GREAT INDIAN PENINSULAR RLY.
SEPARATE BODY SIDE AND ROOF UNITS ANGLE AND TEE CANT RAILS.

FIG 23/17
CLASSIFICATION 3.B



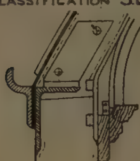
INDIA. SOUTH INDIAN RAILWAY.
SEPARATE BODY SIDE AND ROOF UNIT ANGLE AND TEE CANT RAIL.

FIG 23/18.
CLASSIFICATION 3. B.



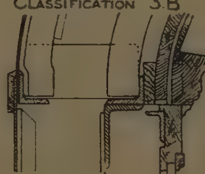
BRITISH. LONDON MIDLAND & SCOTTISH RLY.
BUILT UP BODY SIDE, PILLARS AND ROOFSTICK ANGLE CANT RAIL WITH STIFFENING PLATE FOR WIDE DOORWAYS.

FIG 23/19.
CLASSIFICATION 3.B.



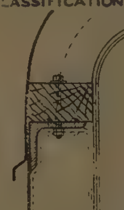
BRITISH LONDON MIDLAND & SCOTTISH RLY
BUILT UP BODY SIDE, PILLAR AND ROOFSTICK CANT RAIL BETWEEN DOORWAYS

FIG 23/20.
CLASSIFICATION 3.B



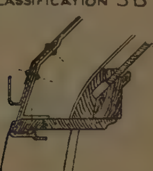
AFRICA - NIGERIAN RAILWAY.
SEPARATE BODY SIDE AND ROOF UNIT WITH ANGLE CANT RAIL.

FIG 23/21.
CLASSIFICATION 3.B.



CHINA SOUTH MANCHURIAN RAILWAY
BUILT UP BODY SIDE PILLAR AND ROOFSTICK ANGLE CANT RAIL.

FIG 23/22.
CLASSIFICATION 3B



BRITISH. UNDERGROUND, ELEC. RAILWAYS LONDON.
PRESSED STEEL COMBINED BODY SIDE PILLAR & ROOFSTICK. ROLLED STEEL PLATE CANT RAIL WITH PRESSED STEEL GUTTER INSIDE FINISH OF TIMBER.

FIG 23/23.
CLASSIFICATION 3.B

BRITISH UNDERGROUND ELEC. RAILWAYS LONDON.
SEPARATE BODYSIDE AND ROOF UNIT PRESSED STEEL ROOFSTICK AND BODYSIDE, PILLAR ROLLED STEEL PRESSED STEEL CANT RAIL

Figs. 23/13 to 23/23.

FIG 24/1.
CLASSIFICATION 3A

U.S.A.

BALTIMORE & OHIO RAILROAD.
LEHIGH VALLEY RAILROAD.
PENNSYLVANIA RAILROAD SYSTEM.

SPECIAL SECTION STEEL WAIST BELT. PRESSED STEEL WAIST. TOP MOULD OF TIMBER. INSIDE FINISH STEEL INSULATED.

FIG 24/2.
CLASSIFICATION 3A

U.S.A.

RICHMOND FREDERICKSBURG & POTOMAC RAILROAD.

STEEL WAIST BELT RAIL. ANGLE STEEL WAIST RAIL. PRESSED STEEL WAIST FINISH. TIMBER SAGGING.

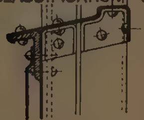
FIG 24/3.
CLASSIFICATION 3A

BRITISH.

LONDON MIDLAND & SCOTTISH RAILWAY.

STEEL WAIST BELT. ANGLE STEEL WAIST RAIL. & ALUMINIUM FINISH.

FIG 24/4.
CLASSIFICATION 3A



U.S.A.

ERIE RAILROAD.

ANGLE STEEL WAIST BELT RAIL. PRESSED STEEL OUTSIDE PANEL. PRESSED STEEL WAIST PANELS.

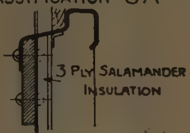
FIG 24/5.
CLASSIFICATION 3A

U.S.A.

READING COMPANY.

ROLLED STEEL WAIST RAIL & MOULD. PRESSED STEEL WAIST, & INSIDE FINISH.

FIG 24/6.
CLASSIFICATION 3A



U.S.A.

LONG ISLAND RAILROAD.

ROLLED STEEL WAIST BELT RAIL. & PRESSED STEEL WAIST.

FIG 24/7.
CLASSIFICATION 3B

JAPAN.

GOVERNMENT RAILWAY.

STEEL WAIST BELT RAIL. PRESSED STEEL WAIST COVERED WITH TIMBER RAIL. & INSIDE PANEL & MOULD IN TIMBER.

FIG 24/8.
CLASSIFICATION 3B

BRITISH.

LONDON MIDLAND & SCOTTISH RAILWAY.

STEEL WAIST BELT RAIL. & PRESSED STEEL WINDOW FRAME. INSIDE RAIL ANGLE STEEL & LIGHT RAIL OF TIMBER.

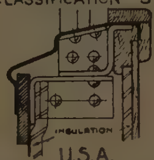
FIG 24/9.
CLASSIFICATION 3B

CHINA.

SOUTH MANCHURIAN RAILWAY.

STEEL WAIST BELT. ANGLE STEEL WAIST RAIL. TIMBER WAIST RAIL. & INSIDE FINISH.

FIG 24/10.
CLASSIFICATION 3B



U.S.A.

NEW YORK CENTRAL RAILROAD.

ROLLED STEEL WAIST BELT. PRESSED STEEL WAIST. INSIDE FINISH & TOP OF WAIST IN TIMBER.

FIG 24/11.
CLASSIFICATION 3B

INDIA.

EASTERN BENGAL RLY. (STATE RLY)

ROLLED STEEL WAIST BELT. PRESSED STEEL WAIST FENCE PLATE. (INSIDE & OUTSIDE). INSIDE PANELLING STEEL. TIMBER FINISH INSIDE & ON WAIST RAIL.

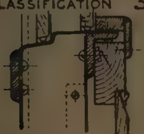
FIG 24/12.
CLASSIFICATION 3B

INDIA.

GREAT INDIAN PENINSULAR RAILWAY.

STEEL WAIST BELT RAIL. ANGLE STEEL WAIST RAIL. & TIMBER WAIST.

FIG 24/13.
CLASSIFICATION 3B

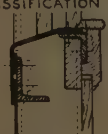


INDIA.

BOMBAY BARODA & CENTRAL INDIA RAILWAY.

STEEL WAIST BELT RAIL. PRESSED STEEL WAIST ANGLE. STEEL INSIDE RAIL. INSIDE FINISH & WAIST MOULD OF TIMBER

FIG 24/14.
CLASSIFICATION 3B



AFRICA.

NIGERIAN RAILWAY.

PRESSED STEEL WAIST. TWO ANGLE WAIST RAILS. INSIDE FINISH OF TIMBER

FIG 24/15.
CLASSIFICATION 3B

BRITISH.

UNDERGROUND ELECTRIC RLY LONDON.

STEEL WAIST BELT RAIL. PRESSED STEEL & ANGLE STEEL WAIST RAIL INSIDE RAIL ANGLE STEEL & LIGHT RAIL TIMBER

FIG 24/16.
CLASSIFICATION 3B

BRITISH.

LONDON MIDLAND & SCOTTISH RAILWAY.

SPECIAL ROLLED STEEL. ANGLE WAIST RAIL. PRESSED WAIST PLATES. INSIDE FINISH OF TIMBER.

Figs. 24/1 to 24/16. — Details of waist rails. All-steel carriages (Classification 3-A and 3-B).

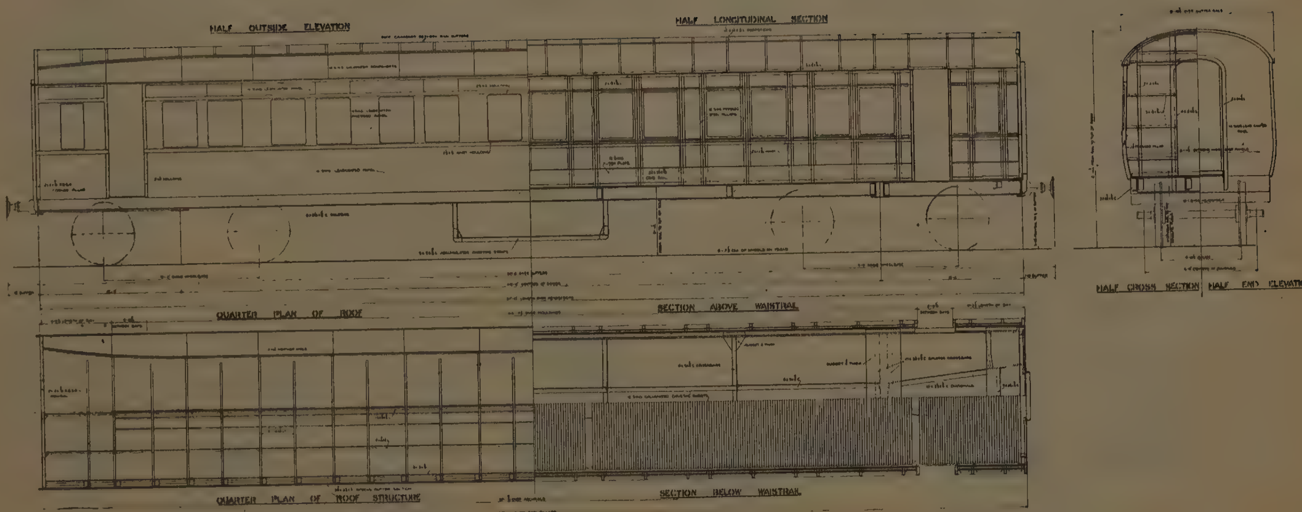


Fig. 25. — Arrangement of steel framing for third class vestibule carriage (Classification 3-A). London Midland & Scottish Railway.

being used for roofing, as well as galvanized steel and black steel sheets.

The following is a summary of the thicknesses and classes of material used for panels on semi-steel and all-steel carriages (table II):

TABLE II.

Railway.	Outside panelling.			
	Thickness, inch.			Description.
	Waist.	Top.	Roof.	
Argentine.				
Central Argentine	0.125	0.1875	...	Mild steel.
China.				
South Manchuria	0.118	0.118	0.079	Steel plates & sheets.
United States of America.				
Baltimore and Ohio	0.125	0.125	0.078	Steel 0.2 % copper bearing.
Lehigh Valley	0 125	0.125	0.0625	Copper content steel.
Long Island	0 110	0.110	0.09375	0.25 % copper sheets.
New York Central	0.125	0.09375	0.125	
Norfolk and Western	0.125	0.125	0.09375 0.0625	Top. Side.
Pennsylvania	0.125	0.125	...	Flat sheets copper bearing open hearth steel. (Partitions 0.0625.)
Richmond, Fredericksburg and Potomac.	0.1875	0.125	0.080	
Wabash	0.1875	0.125	...	
Great Britain.				
London Midland & Scottish	0.064 0 09375	0.064 0.09375	0.062 0.080	M. S. plates, charcoal-finished, lead-coated for side and end panelling, and black and galvanised for roof.
London & North Eastern	0.0625	0.0625	0.0625	Charcoal-finished C. R. panels. Roof M. S. plates.
Southern	...	...		Cotton duck outer.
Metropolitan	0.125	0.125	... (1)0.0625	Galvanished panels. Flat steel plates.
Underground Electric Railways Co. of London.	0.104	0.104	0.064	C. R. C. A. Charcoal-finished. Lead-coated.
Africa.				
Gold Coast Government	...	..	...	Steel sheets, lead-coated, two ground paints, and two enamel.

(1) (Copper for shaped ends.)

Note. — C. R. = Cold-rolled. — C. A. = Close-annealed. – M. S. = Mild steel.

TABLE II (*continued*).

Railway.	Outside panelling.			
	Thickness, inch.			Description.
	Waist.	Top.	Roof.	
Nigerian	0.092 0.09375	0.092 0.09375	0.064 0.064	C. R. C. A. Special rustless steel (locally made ground colour with enamel and varnish generally).
South African Railways and Harbours.	0.092	0.092	...	Steel sheets.
Australasia.				
New South Wales Govt. .	...	...	...	Lead-coated plates. Priming coats of mixed red oxide and black Japan.
Canada.				
Canadian National	0.1875	0.125	...	Copper bearing steel. Sand-blasting and priming.
India.				
Bombay, Baroda & Central India.	0.104	0.080	0.064	Steel sheets.
Eastern Bengal	0.080	0.080	...	Steel sheets. Ord. lead base paint used inside and outside.
Great Indian Peninsula . .	0.080	0.064	...	Metal plates protected on inside by bituminous paints. Outside, ord. oil paints.
South Indian	...	...	...	Flattened steel sheets. Inside and outside painted with ordinary oil paint.
Japan.				
Government Railways . . .	...	0.104	...	Steel sheets.

The replies received shew that in the Unites States of America where the largest number of steel carriages are in service, the method of attaching the panels to the main body framing is by means of snap-headed rivets. The Pullman Company state that in their first carriages, they produced a vehicle which did not have any exposed rivets, but this construction proved costly and unsatisfactory. In Great Britain, both snap and countersunk or flush-headed rivets have been used, the latter giving a more pleasing appearance to the outside of the carriage, and also making it easier to keep the exterior of the carriage clean.

Doubt has been expressed as to the efficiency of the practice of using countersunk rivets, it being thought that if thin plates were joined together, the joints thus formed would not stand the vibration, and that the rivets would work loose,

but provided proper attention is paid to the workmanship, no difficulty should be experienced in using countersunk (flush) heads. Experience in cases of carriages in collision has proved that this method of riveting is satisfactory.

An interesting departure from usual practice has been made by the *London Midland & Scottish Railway, England*, with a carriage with vitreous enamelled steel panelling of the type shewn in figure 26. As is well known, the periodical painting of carriages forms a large proportion of the time occupied for repairs, and it was with a view to reducing this latter period, that the late Mr. R. W. Reid, C. B. E., Vice-President of the London Midland & Scottish Railway, suggested the building of a carriage with vitreous enamelled steel panelling. The design and construction of the carriage in question follows the usual practice for this type of vehicle, but during the course of construction, it is necessary that all the panelling should be drilled and fixed in position on the carriage in order to see that all the rivet holes line up properly before the enamelling processes are undertaken. It will be appreciated that after the plates have been enamelled, any stretching of the plates or the hammering necessary to form the rivet head, would damage the enamel. To get over this difficulty, a special design of snap-headed rivet with a hollow shank is used. The rivet and the method of spinning this hollow rivet down on to the lead washer used, is as shewn in figure 27.

An interesting method of forming the necessary countersunk hole in the galvanized steel panels, has been adopted by the *Great Western Railway, England*, where the hole is punched, and at the same time, the countersunk is formed for the screw head by dishing the plate in one operation. Figure 28 shews the arrangement adopted on this company's carriages, and in order to make the paint grip the panelling, it is the practice to wipe the panels all over before painting with a solution consisting of :

Chloride of copper. . . .	1 lb.
Nitrate of copper	1 lb.
Sal-ammoniac	1 lb.
Muriatic acid	1 lb.
Water	61 lb.

Muriatic acid is added after the ingredients have been mixed with water.

The panelling is then allowed to stand for 24 hours, the following dressing being afterwards applied :

Varnish interior . . .	2 1/16 pints.
Gold size pale mixing.	1/2 pint.
Black japan	1/4 pint.
Oil double boiled. . .	1/8 pint.
Turpentine	5/8 pint.

This is found from experience to be quite satisfactory.

f) Painting.

Generally speaking, the processes adopted do not differ greatly from that for wood, except for the preliminary sand-blasting or cleaning processes that it has been necessary to adopt by many countries. The necessity for protective paints is dealt with in clause 7, item *c*), « Oxidization », and clause 7, item *d*), « Decoration ».

A steel carriage has the advantage that it can be enamelled and the carriage stoved at a fairly high temperature, and the painting processes are thereby quickened up, resulting in the vehicle being released for traffic in a shorter time. Lacquers are also being used both in the United States of America and other countries including Great Britain, the experience so far gained not being sufficiently conclu-

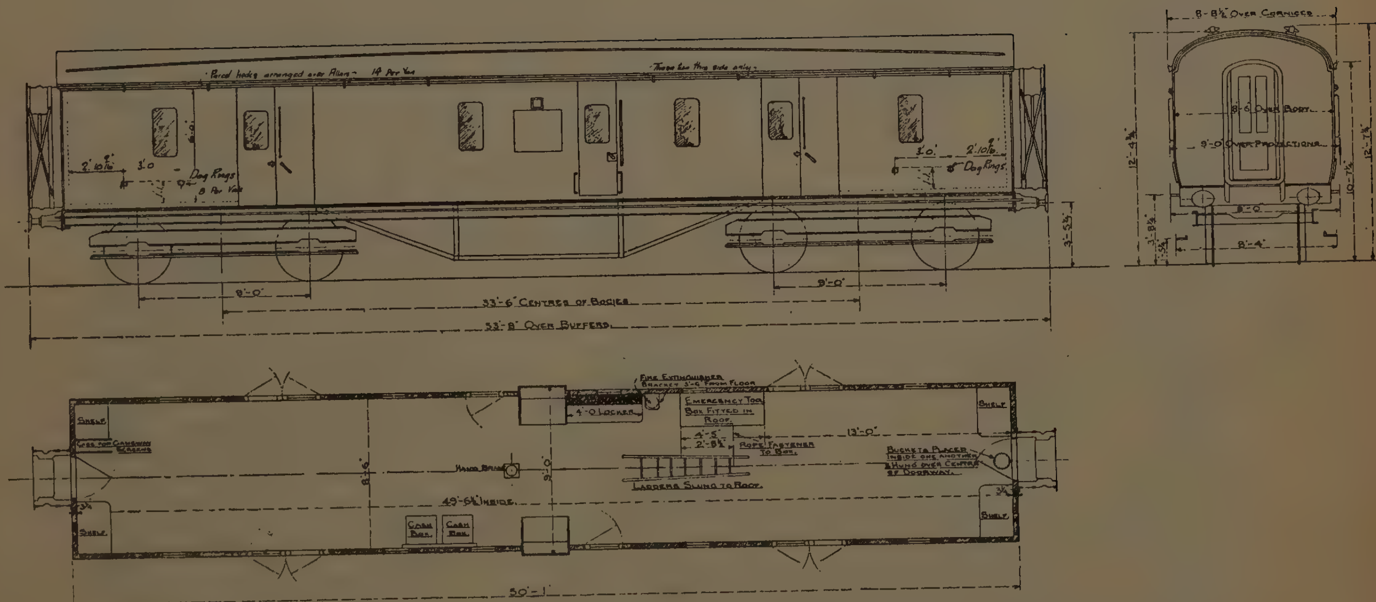


Fig. 26 — Type of passenger brake van, all steel (Classification 3-B) fitted with vitreous enamelled panels, London Midland & Scottish Railway.

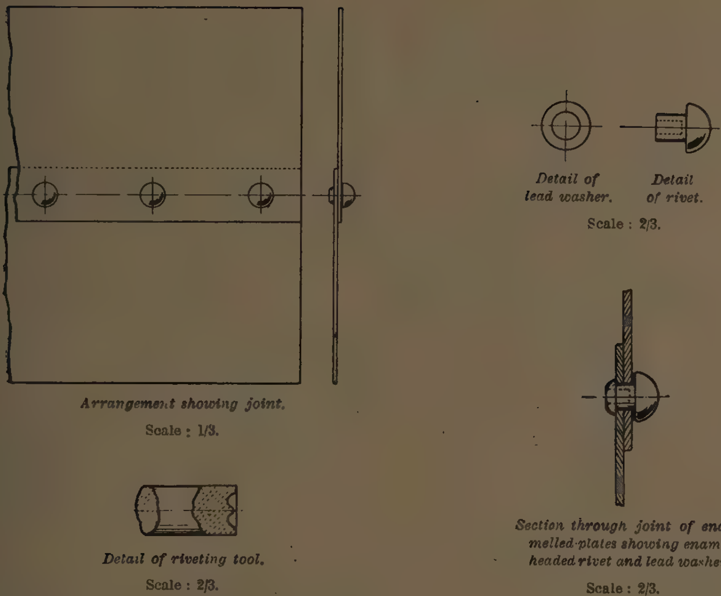


Fig. 27. — Arrangement and details of riveting enamelled body plates of steel carriage (or brake van) (Classification 3-A or 3-B), London Midland & Scottish Railway.

sive for an opinion to be expressed on the subject. The use of lacquers, of course, has the advantage of enabling the painting processes to be speeded up and it would therefore appear that research in the direction of using a suitable lacquer is desirable.

We have thought it desirable to include in this report, the essential points of a specification for the painting of steel carriages, which has kindly been supplied by the *Norfolk & Western Railway, U. S. A.*, and which is set out below :

Norfolk & Western Railway Company.

Painting steel passenger equipment carriages.

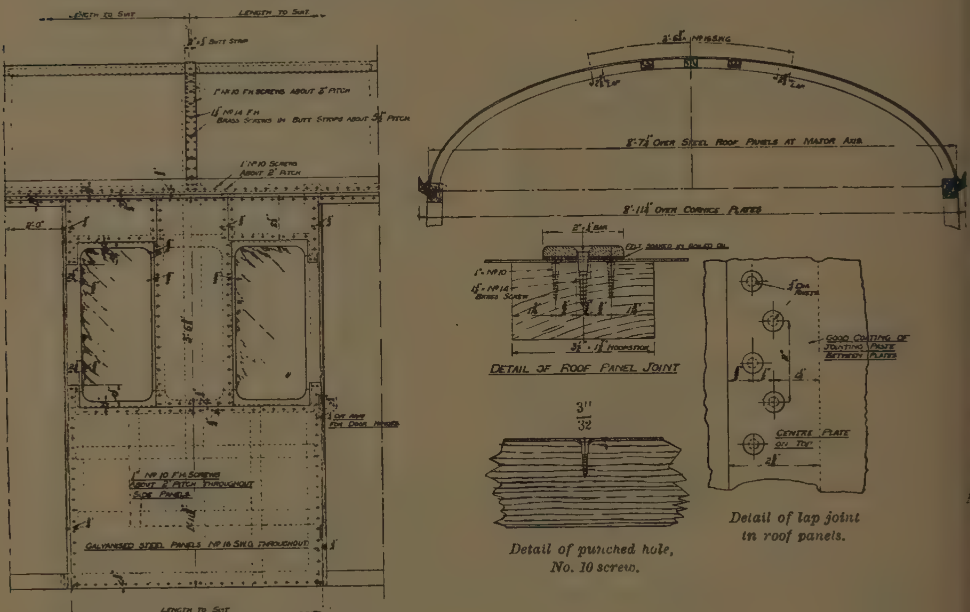
1. The inspector for painting shall have access to all the work at any time, and all operations connected therewith shall meet with his approval. He shall inspect all paints and surfaces to be painted, from the assembling of the steel to the finished carriage.

All items not specifically covered in these specifications are to be finished in a first-class manner, and are to be consistent in every way with the general finish of the carriage.

2. Before they are brought together for riveting, all fittings, inaccessible parts, laps, joints, and all parts where metal is placed against metal, shall first be thoroughly cleaned, and then receive one coat of red lead on each piece. This does not include surfaces where casting comes against casting, but does include surfa-

ces where structural iron or steel comes against casting.

3. When the riveting has been completed, clean off all grease, oils, surplus red lead, etc., etc., and *sandblast thoroughly in a dry atmosphere* all the exterior, including the interior of the vestibules. Immediately after sandblasting, blow off all dust, sand, etc., and prime with *standard red lead;* it is of the ut-



Detail of punched hole, No. 10 screw.

Detail of lap joint in roof panels.

Note. — Holes to be punched where possible. Frame members to be well coated with jointing paste before fixing panels.

Fig. 28. — Panelling methods on carriage stock, Great Western Railway (Great Britain).

most importance that the priming be done immediately after sand-blasting, to avoid any accumulation of moisture on the bare steel. These operations apply to the roof and deck as well as the body of the carriage. Great care must be exercised to see that red lead priming is thoroughly worked in around all rivet heads, laps, joints, etc.

4. Before laying of floor or the final covering of any parts which will be inaccessible in the completed structure, clean off all scale, rust, grease, oil, etc., from the inside of the framing, back of side sheets, roof sheets, false floor sheets, underframing, etc., and prime with red lead.

5. If, for any cause, it should be necessary to remove any of the pieces or rivets and same is replaced by new material, it shall receive same treatment as the original piece.

6. After the riveting, cleaning, sandblasting and priming has been completed, and it is found necessary to do any welding or dressing of the surface, all

such places shall be re-touched with red lead and thoroughly dried before proceeding with the surfacer coats. The carriage is then ready for the surfacer.

13. All underneath or concealed parts of the carriage are after having been thoroughly cleaned, to have one coat red lead and one coat of good *carbon paint,* using nothing but pure linseed oil on the vehicle.

All attachments such as brake rods, air reservoirs, couplers, chains, etc., underneath the carriage are to have one coat of engine finish (black).

15. *Interior finish of carriage and passenger compartment of combined carriage.* — The back of all inside sheets, before being attached to the carriage, are to be thoroughly cleaned of all scale, rust, grease, oil, etc., and primed with *red lead,* and to be further treated in accordance with sections 2 and 5, care being taken that no « holidays » appear in the priming coat.

One of the difficulties with a wooden carriage which has already been pointed out in this report, is that when insufficiently-seasoned timber is used, there is trouble with the paint shelling off, making it necessary to shop the carriage at shorter intervals of time than usually necessary when seasoned timber is used. Provided, however, a steel carriage has undergone the preliminary processes of sand-blasting and cleaning in a thorough manner, the paint is likely to last longer. If, on the other hand, rust or corrosion of any sort is not properly cleaned off the steel panels, then there is likely to be as much difficulty with an all-steel carriage as with a wooden one where unseasoned timber is utilized, or water gets into the panelling.

g) Extent of use of timber.

On the *Central Argentine Railway*, the all-steel carriages (Classification 3-B) have the interior panelling including partitions, made in ply-wood, 5-ply being used up to the waist level, 4-ply between waist and cant rail, and 3-ply for ceilings. The framing of partitions, interior, doors and mouldings is carried out in timber, as well as the run-ways for the metal window frames.

On the all-steel carriages (Classification 3-B) on the *South Manchuria Railway, China,* the interior furnishings are carried out in the first class in mahogany, second class in teak, and third class in « lauan » or pine.

In the *United States of America,* on all-steel carriages (Classification 3-A) it is the practice in the majority of the railways to use timber only for packings, and for attaching metal fittings thereto. In a few cases, timber is used for arm rests, window sashes and sills, but the tendency is to do away with timber for the making of sashes, and substitute this by brass or steel.

The J. G. Brill Co., Philadelphia, state whilst they have hitherto maintained the use of timber for flooring, interior finish and roof in electric railway carriages, the wood interior finish is being replaced by either steel or aluminium.

The Pullman Company, Chicago, have only used wood to a limited extent, *i. e.,* wooden stringers or battens fixed between the steel sheets for the floor support, principally in order to avoid through metallic contact. In the interior of the carriages, the use of wood has been confined to sash rests, arm rests, seat frames, window sashes and the heavier type of doors.

In **Great Britain,** the *Great Western Railway* used in the experimental all-steel carriage (Classification 3-B), timber for inside partitions and panelling.

In the all-steel (Classification 3-B)

vestibule bogie Thirds on the *London Midland & Scottish Railway*, timber has been used for interior furnishings. Wooden doors have been retained, due to the advisability of having ready means of adjustment where the doors are fitted with slam locks.

The *London & North Eastern Railway* fitted in the kitchen cars (all-steel, Classification 3-B), ordinary timber partitions covered with steel plates, whilst the *Metropolitan Company* use timber for all partitions, doors, seats and mouldings.

The *Underground Company* have used timber for interior mouldings, also wood fittings which are bolted to the main framing, for screwing interior panelling and mouldings into position.

In **Africa**, timber has been generally used for doors, window frames, and small miscellaneous packings and mouldings.

In **Australasia**, the *New South Wales Government Railways* have used wood for the window sills, louvre blinds, and for packing purposes.

In **Canada**, the *Canadian National Railways* have used timber for all interior furnishing, floors, partitions and doors.

In **India**, the *Bombay, Baroda & Central India Railway* have fitted lower class seats in timber, and have also used this for interior furnishings other than roofs, asbestos millboard being used for the latter. The *Eastern Bengal Railway* have only used wood in seat backs, door stiles, door pillars and glass frames. The *Great Indian Peninsula Railway* have used timber for interior furnishings, but ceilings have been made up in asbestos sheeting. The *North Western Railway (State Railway of India)* have used wood for interior furnishings, and the *South Indian Railway* have used timber for battens for seats, parcel racks, door framing and light mouldings.

In **Japan**, the *Government Railways* have used timber for roofs, interior furnishings and flooring.

h) Special alloys.

« Alpax » alloy is being used for window frames, parcel racks and seat castings in the **Argentine**. In the **United States of America**, different grades of aluminium are being used for various parts of the carriage on the *Pennsylvania Railroad;* the *Reading Company* are considering the use of aluminium copper alloy at the present time, and the *Richmond, Fredericksburg & Potomac Railroad* have used aluminium for the interior furnishing of gas-electric rail cars. The J. G. Brill Co., Philadelphia (U. S. A.) report having used light metals to reduce weight *i. e.*, aluminium panels, and in three cases, aluminium has been used in its entirety in the construction of the carriage body except the flooring, roof and mouldings, also on one lot of carriages where the vehicles, except wheels, axles and springs, journal bearings and brake shoes, were constructed entirely of aluminium alloy.

In **England**, the *London Midland & Scottish Railway* (in the construction of the electric carriages for the Manchester and Bury Electric Lines) used rolled sections of alloy steel 40-45 English tons per square inch tensile strength, 25-30 % elongation in 2 inches, for solebars, headstocks, bolsters, longitudinals to headstocks, and needle beams, instead of mild steel of a tensile strength of 28/32 English tons per square inch and 20 % elongation in 8 inches, with a view to reducing the weight. The *London and North Eastern Railway* have used aluminium alloy for seat ends on open Thirds and rail cars, and the *Underground Company*

are using aluminium alloys for doors and interior fittings.

The *New South Wales Government Railways* (**Australasia**) are now fitting doors composed of aluminium silicon alloy, and aluminium copper alloys cast in one piece.

« Alpax » alloy is also being used for doors on the *Bombay, Baroda & Central India Railway.*

i) Heating and insulation.

Owing to the quicker heat transference in all-steel carriages as compared with wood, heat losses are bound to occur, unless steps are taken to insulate with asbestos or other type of blanket. Whilst certain railways in **Africa, Australasia** and **India** have stated they have no problems to meet on this point, **China**, the **United States of America**, and other railways in **Africa, Canada** and **India** report the adoption of insulation. In the **Argentine**, it is the practice to use cellular waterproof asbestos, whilst in **China**, felt and asbestos paper are used for a similar purpose. A further precaution taken in the latter country, is to fit a false floor of sheet metal with a compound board inserted.

To meet the problem of insulation on the all-steel carriages (Classification 3-B) on the *London Midland & Scottish Railway*, **England**, some of the carriages have a pocket between the steel plates and interior finishing, sealed up. An insulating material is attached to the plates on the inside, this being secured to the panels either by bitumastic solution or cement, and in some cases, narrow steel binding strips are added. In other carriages, a free air space is arranged between the outer steel panels and the interior finishing (fig. 29).

In order to obtain some data as to the quicker heat transference in steel as compared with wooden carriages, we have had some special tests carried out under the following conditions :

Eight carriages each 57 feet long were selected, all of which were constructed at approximately the same time, and particulars of these are as follows :

Number.	Type of carriage.	Construction and classification.	
1	3rd class vestibule.	All-steel.	3-B.
2	do.	do.	3-B.
3	do.	do.	3-B.
4	do.	Wood.	1
5	3rd class vestibule with one brake compartment.	Wood.	1
6	do.	All-steel.	3-B.
7	do.	do.	3-B.
8	do.	do.	3-B

These were placed in the open, and heated by steam to a temperature of 25° F. above that of the outside air. Steam was then cut off, and the fall in temperature

Fig. 29. — Section through body side shewing free air space. All-steel carriage (Classification 3-B), London Midland & Scottish Railway.

in each of the carriages was recorded, these being shewn in figures 30, 31 and 32. The following points were noted as a result of the test :

1. In vestibule carriages, the loss of heat is much more rapid in all-steel vehicles (Classification 3-B) than in those constructed of wood (Classification 1).

2. There was very little difference in the ratio of cooling in the all-steel carriages (Classification 3-B).

3. The fact that in addition to the air space between the inner and outer casings, a small amount of insulating material was incorporated in the construction of some of the all-steel carriages (Classification 3-B), was not noticeable in the results of the tests.

4. Average figures taken from a number of tests shew that for a difference in temperature of 20° F. the loss of heat per minute is :

All-steel carriages (Classification 3-B) : 0.15° F.;

Wooden carriages (Classification 1) : 0.10° F.

On this basis, the difference between wood and all-steel carriages is of more importance in countries with temperate conditions such as Great Britain, than in those countries where owing to more severe wintry conditions, greater differences in temperature have to be maintained.

5. The effect of a 50 % greater heat loss in all-steel carriages (Classification 3-B) in steam-heated trains will seriously affect the reduction in pressure along the train, and increase the difficulty of heating the rear carriages. With carriages electrically-heated by axle-driven generators, the difference in power consumption is a matter of considerable economic importance.

With the object of ascertaining the effect of running conditions, a trip was taken with eight carriages marshalled as shewn in figure 33. The carriages were

heated before starting, and the steam supply was cut off immediately the run was commenced. The fall in temperature is shewn, but whilst it should be noted that cold air was admitted to carriage No. 3 owing to a fallen droplight, it will be seen that the difference between all-steel carriages (Classification 3-B) and wooden carriages (Classification 1) is very marked.

j) **Interior fittings.**

In most countries, it appears to be the practice to arrange interior fittings in steel carriages in a similar manner to the system adopted with wooden carriages.

In the United States of America, interior fittings on carriages of all-steel (Classification 3-A) construction, are attached in various ways, as for example :

a) By the use of wood fillers attached to the steel framework, and the use of wood screws for fitting attachments;

b) By machine screws in tapped holes in the framework;

c) By special formation of various parts of framework to receive the interior fittings and attachments, to be screwed or bolted into place.

Clause 5. — Maintenance costs.

The relative maintenance costs of carriages of all-steel and wood, provided the vehicles are given proper attention, should be about equal, which as far as life is concerned, may be expected to become obsolete before they are worn out. Various reasons have been advanced to shew that maintenance costs should be lower for steel carriages than for wood, such as :

Argentine.

Central Argentine Railway. — Steel has longer life in certain districts.

China.

South Manchuria Railway. — Increased strength and rigidity.

United States of America.

Baltimore & Ohio Railroad. — Longer period between repairs.

Erie Railroad. — No wooden structure to deteriorate, and less attention required to roofs.

Less painting required.

On the other hand, certain railway companies have expressed the opinion that expenditure on steel carriages will be heavier or about the same as for wooden carriages, for such reasons as :

United States of America.

Norfolk & Western Railway. — When carriages are new, decided advantage in favour of steel, but average through life about the same.

Africa.

South African Railways & Harbours. — Removal and replacement of fittings more costly than in the case of wooden carriages, but not such heavy repairs required.

India.

Eastern Bengal Railway. — Extreme humidity of certain climates causing oxidization of light body framework and panel plates to be rapid.

It has been extremely difficult to obtain any reliable data as to repair costs, owing to no separation having been made between repairs to wooden and steel carriages respectively, and the majority of railway companies excepting those in the United States of America, state that their experience is too limited to express an opinion.

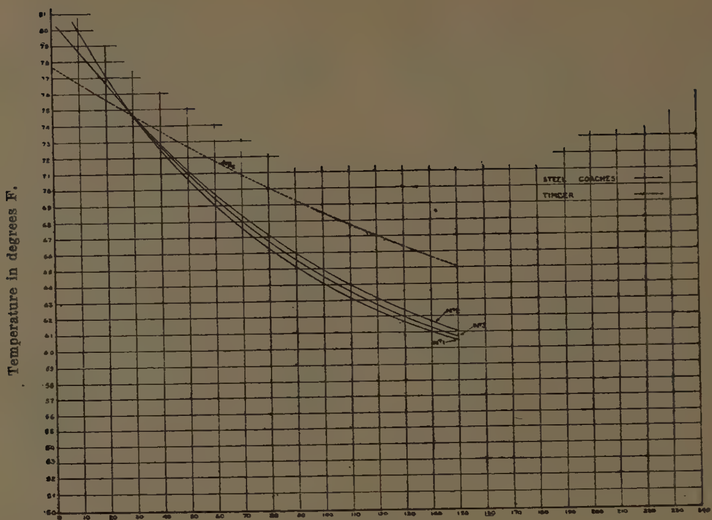


Fig. 30.

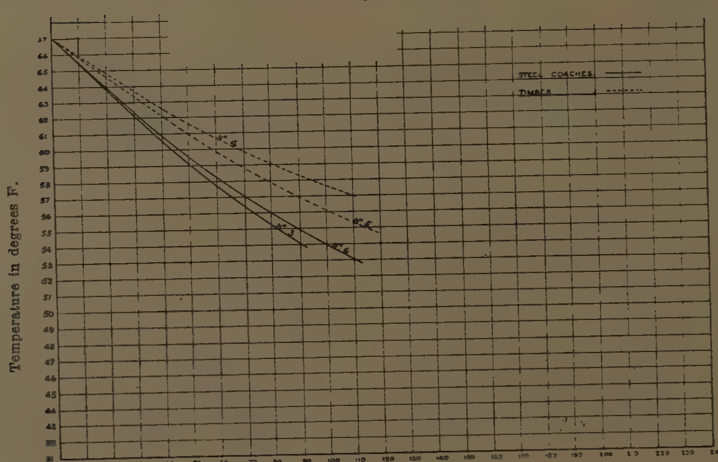


Fig. 31.

Figs. 30 to 33. — Heat conductivity of carriage bodies. Tests made by the London Midland & Scottish Railway.

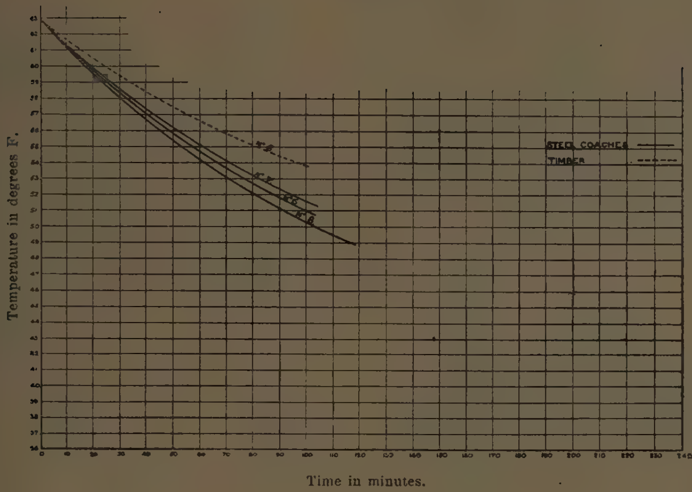


Fig. 32.

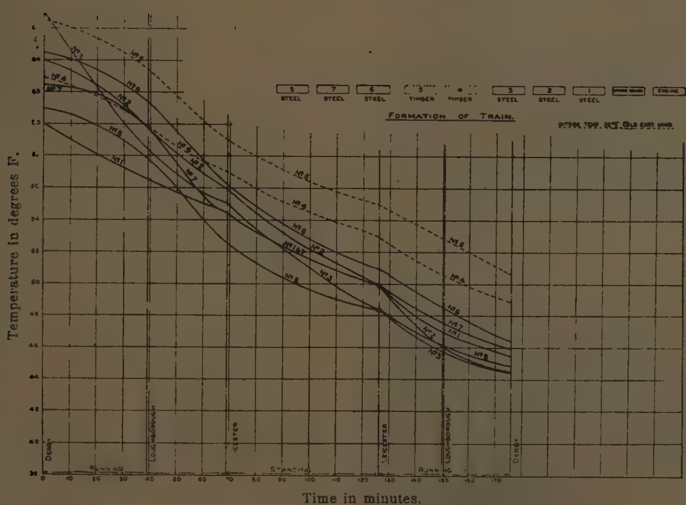


Fig. 33.

Figs. 30 to 33 (*continued*).

One railway company in the United States of America, *i. e.*, the ***Wabash Railway***, state that taking the costs over a ten years' period, the average yearly expenditure per carriage in repairs is as follows :

Steel	983 dollars.
Wood	1 212 dollars.

This represents a saving of 19 % in favour of steel against wood.

Carriage maintenance costs can be split up under the following heads :

a) Body;

b) Underframe, including wheels, axleboxes, buffing, drawgear, etc.;

c) Interior, upholstery and decorative panelling, etc.;

d) Lighting system — electric or gas;

e) Steam or other forms of heating;

f) Brake;

g) Lavatory fittings;

h) Painting.

In analysing the advantages of the steel carriage, it is well to go through the above list to select those items upon which, presuming steel carriages were in use, a saving in maintenance would be effected, and it is suggested that the only savings on purely maintenance costs which could be obtained from the steel carriage as compared with the wooden carriage are in the repairs to the body, and painting.

Clause 6. — Experience in traffic.

a) Comfort of passengers.

When the proposals were first put forward for the construction of all-steel carriages (Classification 3-B), opinions were expressed that the carriages would « drum » and be less comfortable for passengers to ride in, but experience has proved that if a properly insulated carriage is constructed, it is doubtful whether passengers can tell if they are travelling in a steel or a wooden carriage. From the test described in clause 4, item *i*), « Heating and insulation », it is considered that the heating surface requires to be increased 50 % to allow for the quicker heat transference in the case of an all-steel carriage (Classification 3-B) as compared with a wooden carriage.

With the use of wood for interior furnishing, the question of discomfort due to having metal arm rests does not arise, and there is the further advantage that an all-steel carriage (Classification 3-B) with wooden interior furnishings, electric lighting, and assuming insulation or air circulation is satisfactorily arranged, is a satisfactory compromise between the wooden carriage and all-steel (Classification 3-A), because such a carriage has the following advantages :

a) Retains the strength of an all-steel carriage (Classification 3-A);

b) Has the appearance of a wooden carriage whilst the passenger is inside;

c) Does not require so much extra heating surface as an all-steel carriage (Classification 3-A).

b) Accidents.

An all-steel carriage is undoubtedly safer in case of collision than a wooden carriage. The difficulty with a wooden carriage is that in collision, the steel underframes tend to over-ride one another, and the wooden body is sheared through by the steel underframe overmounting, resulting in considerable injury to passengers.

Various devices have been fitted to wooden carriages to try as far as possible to overcome this tendency, and one very interesting arrangement is an anti-telescopic apparatus (fig. 34) which has been fitted on the late *Great Central* Section of the now *London & North Eastern Railway, England,* which was introduced by Mr. J. G. Robinson, C. B. E., late Chief Mechanical Engineer of the Great Central Railway, in conjunction with the *Metropolitan Carriage Wagon & Finance Company, Limited,* and 65 vehicles were eventually fitted. The main features are the strengthening of the ends of the coach by means of steel members, and fitting of interlocking fenders and a special design of the buffers, which are illustrated in figure 35. In the event of collision, the buffers come hard together, and an arrangement is made whereby the buffing springs shear the pin at a pre-determined pressure resulting in the interlocking fenders engaging, thus preventing the over-riding of the underframe.

In a design of carriage stock with wooden bodies and steel underframes, which has stood up well in collision, is the articulated arrangement introduced by Mr. H. N. Gresley, C. B. E., Chief Mechanical Engineer of the *London & North Eastern Railway, England.* A bogie is placed under the extreme end of each set of vehicles, and intermediate bogies are arranged to support the ends of adjacent carriages, a special form of centre casting acting as a coupler (fig. 36). Details of this coupler are shewn in figures 37 and 38.

Figure 39 reproduced by the courtesy of *The Daily Mail* shews how the articulated carriages held together.

Very little information has been submitted as to the behaviour of steel carriages in cases of accident, but the fol-

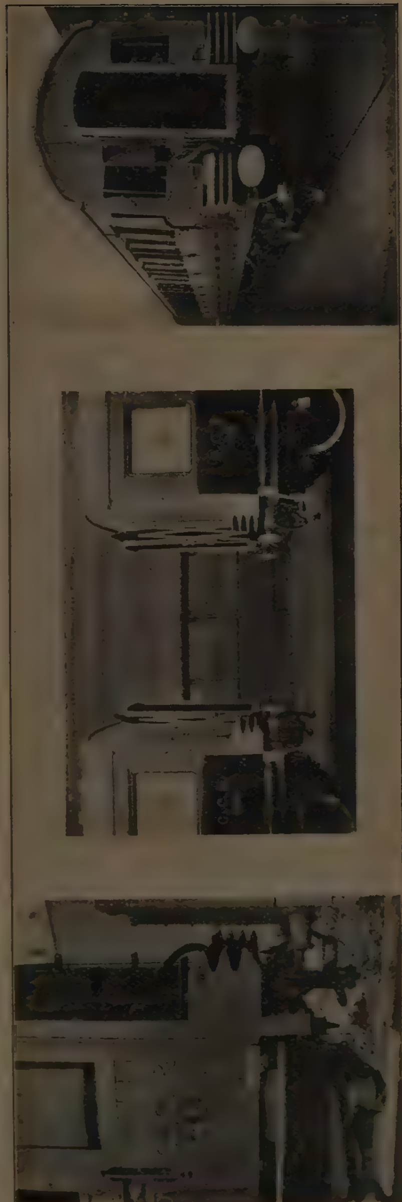
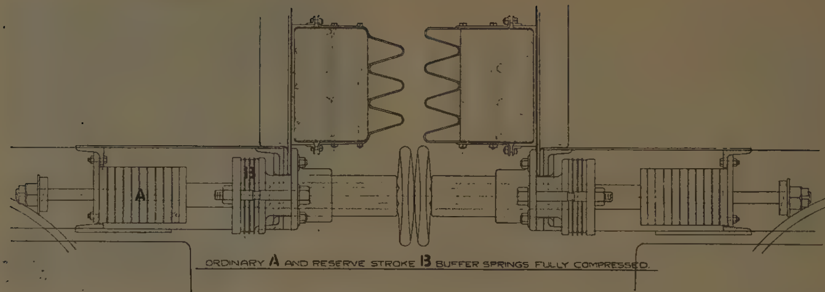


Fig. 34. — Carriages fitted with Robinson's anti-telescopic apparatus, London & North Eastern Railway.



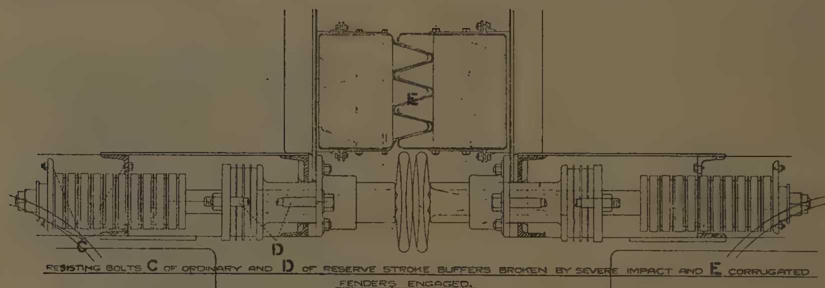


Fig. 35. — Robinson's anti-telescopic apparatus. Details of interlocking fenders and buffers, London & North Eastern Railway.

lowing comments shew broadly various companies' experiences :

United States of America.

Baltimore & Ohio Railroad. — Withstand distortion from shocks more than wooden carriages, and not inflammable like latter.

Erie Railroad. — In the few derailments concerned, the steel equipment next to the locomotive protected the remainder of the train.

Lehigh Valley Railroad. — Not damaged so seriously as wooden carriage, and few passengers injured.

Long Island Railroad. — Special advantage in a wreck, as they present no fire hazard and hold together better.

New York Central Railroad. — Superior to wooden carriages both as regards resistance to damage and fire.

Norfolk & Western; Pennsylvania; Reading; Richmond, Fredericksburg & Potomac and Wabash Companies. — Records shew less damage than wooden carriages, and fewer passengers injured.

India.

Great Indian Peninsula Railway. — In minor accidents, only needed pillars straightening and panels replacing. Wooden carriages would have had the majority of pillars broken.

There seems no doubt that provided the whole train is of steel construction, they are safer than wooden vehicles, and

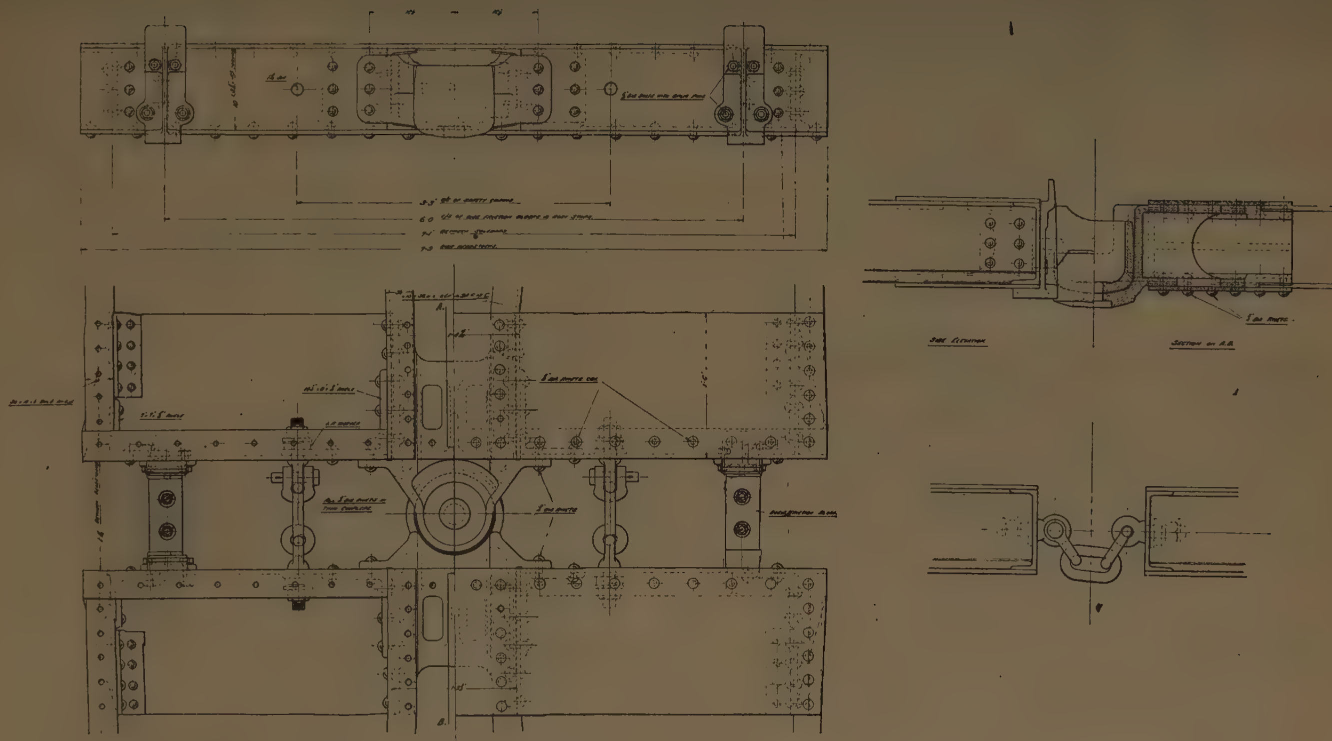


Fig. 36. — Arrangement of twin coupler on steel underframe of articulated carriage, London & North Eastern Railway.

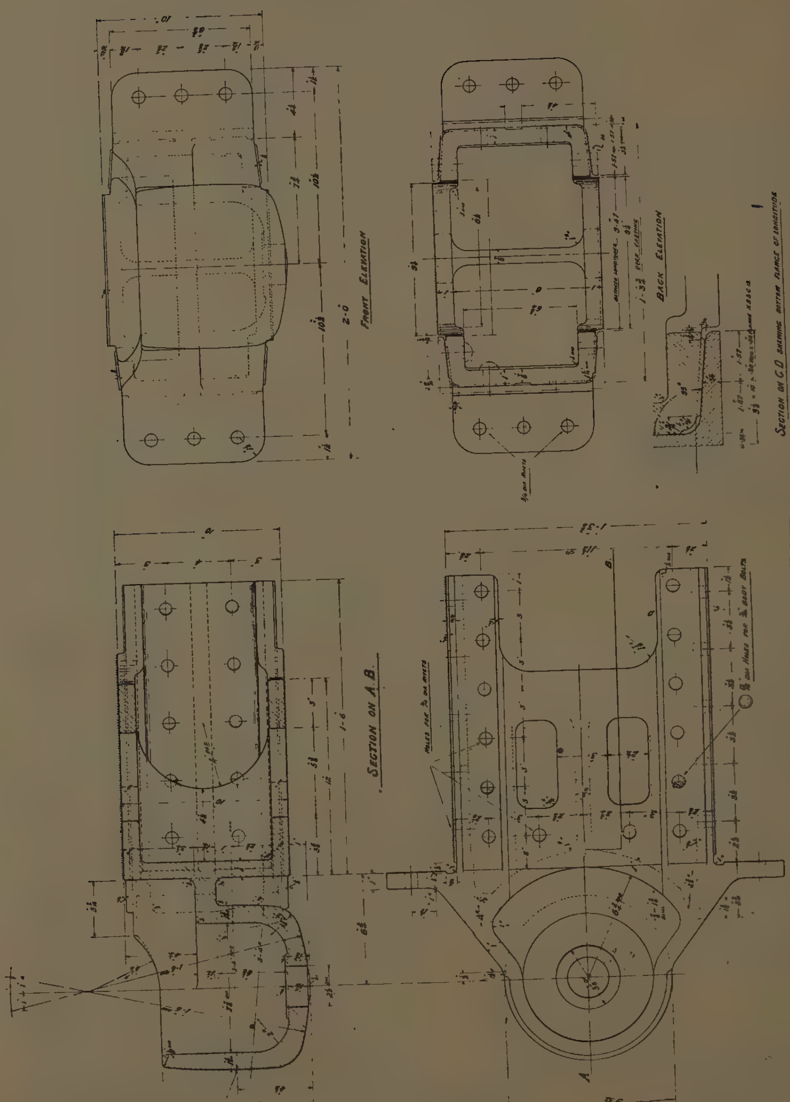


Fig. 37. — Cast steel inside twin coupler of articulated carriages, London & North Eastern Railway.

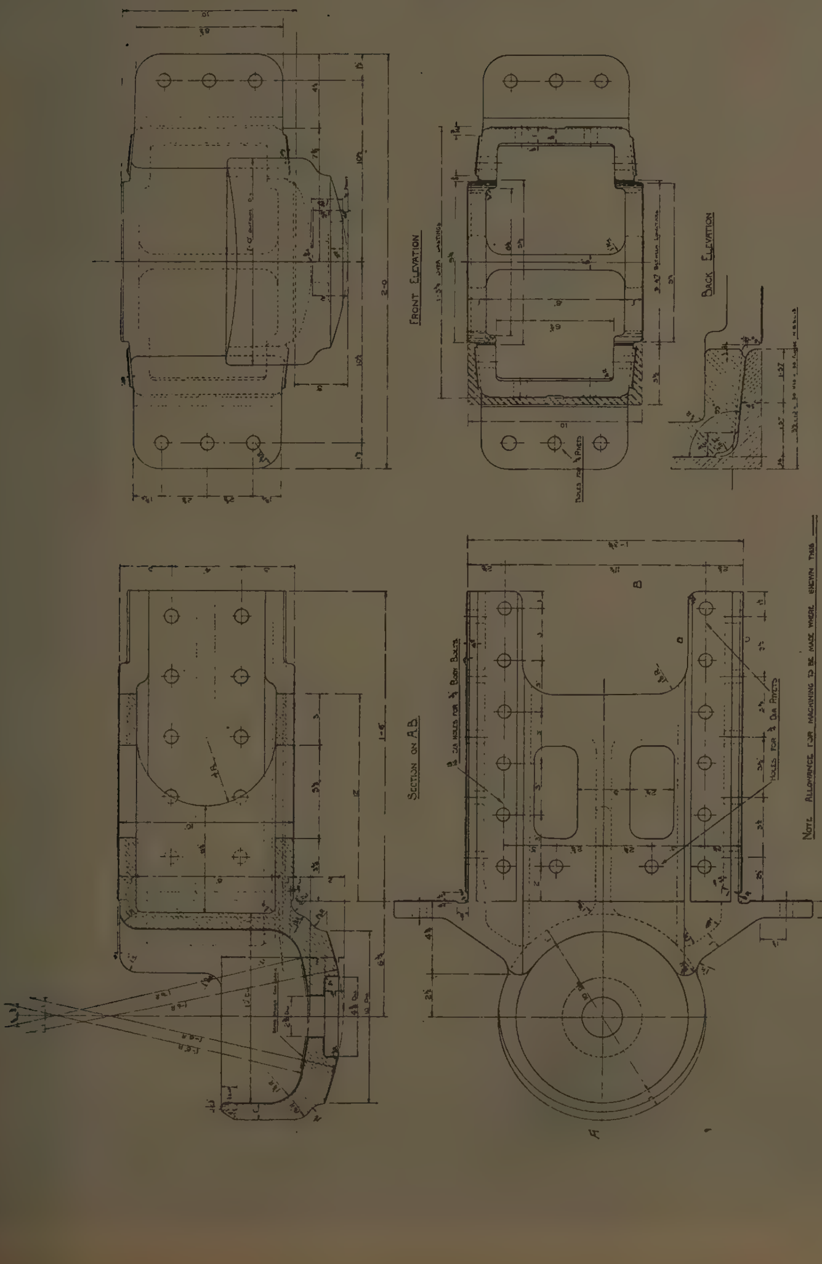


Fig. 38. — Cast steel outside twin coupler of articulated carriage, London & North Eastern Railway.

Fig. 39.—Articulated carriages, London & North Eastern Railway.

instances of the behaviour of all-steel carriages are set out below :

1. In the case of three collisions which took place with all-steel electric carriages (Classification 3-A), it was found that the damage was confined to the ends of the carriages. The doorways were the principal buckling points, being at the extreme ends of the carriages and having vestibules, and absorbing the blow. The carriage structures absorbed the force of impact.

2. An all-steel (Classification 3-B) corridor bogie brake van fitted with « Spencer's » shock absorbing buffers, and electrically-lighted, was next to the engines of a passenger train weighing 347 tons (677 280 lb.) (exclusive of engines) which overtook and collided with a goods train of 34 wagons and brake van. The two engines of the passenger train were thrown off the track, and the steel brake van had only about five feet of the underframe torn away at one end from the body structure, which except for a few indentations, was practically otherwise undamaged.

In the event of a heavy collision, wooden carriages are liable to be telescoped due to steel underframes mounting and shearing the superstructure of the wooden carriage. They have the disadvantage that once it has given way, it offers little resistance to the crushing energy of the collision; whereas steel carriages, even after the material has once begun to give way, offer a greater resistance to the shock.

The behaviour of trains of steel carriages in collision shews that the end platforms and vestibules of the open type form a natural buffer and « yieldpoint » accepting at any rate, first energy of the collision, by crumpling up the vestibules.

Clause 7. — Steel carriages. — Particular phases of difficulty as compared with wooden carriages.

a) Ventilation.

In those countries affected by considerable variations in temperature, steps have to be taken (as described in clause 4, item *i*, « Heating and insulation » to provide sufficient insulation, and it is the custom to arrange electric fans and extractors at convenient points to obtain a movement of air in the carriages whether travelling or standing, and in cold weather, an even distribution of freshly-heated air.

b) Noise.

Provided a carriage is blanketted similar to what is done in American practice, there should be little, if any, additional noise than in the case of wooden stock. In the latter there is generally a certain noise due to creaking of the wooden joints, but in the steel carriage, owing to it being riveted up, this reduces the number of joints, and the following are different methods which have been adopted to lessen the noise in steel carriages :

a) All pipes securely clamped;

b) False floor inserted;

c) Maintaining tight joints;

d) Rubber pads to springs;

e) Asbestos sheet lining on seat risers over wheels;

f) Asbestos sheet fitted between floor plate and wood slats;

g) Side panels lined with canvas;

h) Cork floors used;

i) Inside sheathing backed with baize;

j) Decolite and Induroleum used for floors;

k) Packing between interior finish and framing, also rubber below body centre plate, side bearings, platform buffers, etc., etc.

c) **Oxidization.**

Attention has been called by certain railway companies to the tendency of oxidization taking place at the joints, and steps must be taken to reduce the tendency as much as possible. The practice of some companies is to apply on the interior panels, several coats of red lead, and to insert between the rivet joints and flanges, a fabric soaked with red lead. In other cases, it has been arranged for air circulation between the interior finish and exterior panel, in order to prevent as far as possible, corrosion taking place due to moisture adhering to the panels through changes in temperature.

The *Pullman Co.*, Chicago, depend on paint protection and to a certain extent on galvanizing to prevent oxidization. Roof sheets, ventilators and sill steps are galvanized, and in addition, the galvanized surface is covered with paint.

The *J. G. Brill Co.*, state that they have taken special steps by the use of good steel primers and surfacers, care being taken to clean the metal thoroughly before applying the paint, and in addition, the periodical addition of protective coats.

The *New York Central Railroad* report the adoption of copper bearing steel for passenger carriage roofs. The cost is 8 % more, but a copper content of 0.2 % increases the ability of the steel to resist atmospheric corrosion.

Other methods employed to prevent corrosion are :

a) Use of lead-coated steel panels;

b) Interior panels painted with red oxide;

c) Plates sand-blasted prior to painting;

d) Joints treated with red lead;

e) Graphite paints used for concealed parts.

In India, the *Eastern Bengal Railway* call attention to the necessity for care in the use of steel in the damp climate of Bengal, due to corrosion setting in very quickly.

d) **Decoration.**

With the advent of steel carriages, doubt was originally expressed as to the possibility of making these as pleasing to the eye as wooden carriages, but a survey of the methods adopted shews that very little, if any, difficulty has been experienced. The use of steel mouldings has materially assisted in the general scheme, and such a good finish is obtained as to make it difficult to tell the difference from a wooden coach.

Graining and varnishing is used for decorative effect in addition to natural wood finish, French-polished. Lining and stripes in gold are resorted to for high-class carriages, but a good enamel finish has been attained by many railway companies, and this is considered to be quite satisfactory.

Clause 8.
Necessity for further research.

The opinion is freely expressed that there is necessity for further research in the following directions :

a) Reduction in first cost;

b) Reduction in maintenance cost;

c) Reduction in tare weight;

d) Use of special alloys for underframe construction and interior furnishings, and development of suitable materials to resist oxidization;

e) Necessity for good system of insulation, and also prevention of noise;

f) Substitute for increasing cost of timber.

a) Reduction in first cost.

In considering the present increased first cost of a steel carriage as compared with a wooden one, the advantage of having a stronger structure should not be lost sight of. It is desirable that the first cost of steel carriages should approximate to that of wooden carriages, and no doubt the price will be reduced as more steel carriages are built, and greater experience obtained by builders.

b) Reduction in maintenance costs.

In comparing the maintenance costs of all-steel carriages with those of wooden construction, it would appear that any anticipated reduction might be looked for under the headings of « Painting » and « Repairs to body-work », provided the carriages are kept properly painted, and corrosion of the panels is prevented; there should be a certain saving on the painting due to it not being necessary to take out split panels or burn off those which have had the paint destroyed due to wet getting in.

c) Reduction in tare weight.

It will be noted from the figures given in clause 3, that in most cases there is an average of 10/15 % greater tare weight in a steel carriage compared with a wooden one of the same type, although as previously pointed out greater strength and resistance is given in cases of accident, and it is a matter for consideration as to how the tare weight can best be reduced whilst maintaining sufficient strength, also the question should be considered as to whether the use of special alloy steel of a greater tensile strength will enable smaller sections to be used.

d) Use of special alloys for underframe construction and interior furnishings, and development of suitable materials to resist oxidization.

The use of suitable alloy steel would materially assist in the consideration of the subject of « Tare weight », clause 8, item *c*, and research directed to finding alloys of sufficient strength and non-corrosive providing they are not too expensive, would be advantageous, both for underframe construction as well as interior furnishings.

e) Necessity for good system of insulation, and also prevention of noise.

The great variation in summer and winter temperatures in certain countries presents a problem in the matter of insulation. Whatever form of insulation is used, it should be *non-hygroscopic* otherwise condensation will collect on the insulation, resulting in the panels corroding, and the trouble will not be discovered unless the insulation is taken out, hence the methods shewn in figure 29 where use is made of the interior casing of the carriage to give an air space between the outer shell and the inner case, is a partial solution of the difficulty, but for climates where there is a wide variation in temperature, insulation by this means will probably not be sufficient.

f) Substitutes for increasing cost of timber.

It is of note that this reason for the necessity for further research is supported by Africa and India, from which it is evident that there is a strong fear that supplies of teak are likely to be reduced.

It is of interest to note that so far as Great Britain is concerned, there is no perceptible decline in the imports of timber for 1927 as compared with 1913, although for the intervening years, these are slightly less.

Clause 9. — SUMMARY.

As a result of the examination of the replies received to the Questionnaire submitted to the various railway companies, we draw up the following summary :

1. The substitution of steel carriages for those built of wood, will continue. In the United States of America, the building of wooden carriages has practically ceased, and in Great Britain, the tendency is to turn to steel carriages for the following reasons :

a) Steel carriages are much safer in case of accidents than wooden carriages. As weight for weight, the steel carriage has a very much greater stiffness and strength;

b) Steel being a manufactured product, there is no likelihood of a shortage in supplies, with a consequent increase in price;

c) Steel is manufactured in Great Britain, and the raw materials used in the manufacture of steel are carried by the railways, and to that extent, this transport increases the revenue of the railway companies;

d) There should be a reduction in maintenance costs provided the tendency to corrosion of thin sheets can be satisfactorily overcome.

2. First costs of steel carriages are gradually decreasing, and costs for painting are likely to be less, as there is not the same tendency for paint to shell off as is the case when timber is used which may be insufficiently seasoned.

3. The production of steel carriages which will eliminate the risk of injury to passengers, is a point to influence the travelling public in favour of railway travel.

4. It is possible to produce a steel carriage with wood interior finish which will eliminate many difficulties now experienced in the way of oxidization, noise, condensation (provided proper precautions are taken to thoroughly protect metal surfaces), reduce number of parts to a minimum, insulate adequately, and keep in a good state of repair.

5. That a metal interior finish is not advisable in those countries having humid conditions, and where steel is used for underframes and body portion, special steps should be taken to use protective material, and give regular attention in this respect.

Clause 10. — Acknowledgments.

We desire to acknowledge the information so readily supplied by the various railway companies in the countries covered by this report, as well as particulars supplied by many contractors who have built carriage stock for use in England and the British Colonies.

We also tender our thanks to *The Railway Gazette* and the Chief Mechanical Engineers and Carriage and Wagon Superintendents who have allowed the publication of the drawings, photographs, etc., included in this report, the preparation of which was only made possible by the courtesy of the late Mr. R. W. Reid, C. B. E., Vice-President of the London Midland & Scottish Railway Company, England.

APPENDIX.

APPENDIX.

Summary of railway practices (Replies to detailed list of questions).

QUESTION.	Argentine.		China.
	State Railways.	Central Argentine Railway.	South Manchurian Rys.
1. **Advantages of all-steel construction.** a) *Do you consider it is desirable that further researches should be made in the direction of metal (steel) vehicles?*	Yes.	Yes.	Yes.
b) *What are the reasons which justify you in this belief?*	Advantages: Reduced expense of upkeep. Longer period between shoppings, longer life, greater resistance to shocks.	Steel more advantageous except perhaps from painting point of view. Rigidity of coach sides which form a truss in themselves prevent independent working of members of coach body thereby reducing to a minimum cost of maintenance of louvres, windows, etc.	Further study needed as to weight, heat insulation, prevention of oxidization of steel plates. Advantages are increased strength, fireproofness, and reduction of injury in cases of collision.
2. **Type of carriages in service, under construction or projected.** a) *Have you built or considered the building of metal coa-*	...	...	No. Semi-steel cars in use are best for local condi-tions.

ciple underlying their construction?	solebars provided with truss bars.	standard practice for steel underframe wooden bodied stock. Truss rods abolished. Steel exterior and framing for body introduced supporting the weight. Ample ventilation provided to avoid corrosion.	
c) *Stronger underframe with a lighter body.*	...	Strength of underframe retained due to buffing shocks met with.	Yes, chiefly applied to carriages with end doors only, and suitable for those with auto centre couplers; strength of end construction and body framing is being increased against telescoping, derailment, etc.
d) *Lattice-work solebars.*	...	No special design such as latticing or tubular construction has been introduced.	No.
e) *Bulkhead tubular section.*	...	No.	No.
f) *Has this method of construction been applied or is it a practical proposition in regard to :*			
1. *Carriages with end doors (only).*	...	Fitted with end doors generally (except for odd side door in such vehicles as kitchen and dining cars) the sides being intact.	Yes.
2. *Carriages with side doors.*	...	...	No.
3. *Suburban and District sets.*	...	...	Yes.
4. *Carriages on light railways (tramways).*	...	...	...

QUESTION.	Argentine. (*Continued.*)		China. (*Continued.*)
	State Railways.	Central Argentine Railway.	South Manchurian Rys.
3. **Process and materials of construction.**			
a) *What are the principal materials you have used in the construction of such vehicles profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Principally sheet steel plates, stampings and malleable castings.	Mild steel roof and side plates. Pressed steel framing members, insulation of cellular waterproof asbestos.	Underframe is of built up type steel plates, steel angles and pressed steel plates being used, centre sill is of the fish-belly type. Body framework consists of steel plates, angles and pressed steel which are securely riveted together to the underframe.
b) *How do you constitute the floor of the vehicle?*	...	Constructed of dovetailed galvanized steel sheeting attached to underframe and covered with Decolite (asbestos composition)	Constructed with two wooden boards putting one over the other, building paper being inserted between them. Floor of first class is linoleumed and carpeted. Second class is linoleumed and third class floored with painted bare wood.
c) *Have you utilized light metals (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	...	Light metal alloy « Alpax » used for window frames, parcel racks, and seat castings.	No.
d) *What methods of assembly have you adopted, riveting, oxy-acetylene welding or electric arc or spot welding?*	Riveting.	Riveting with snap heads.	Riveting is generally adopted for the assembly of the car body. Oxy-acetylene welding locally.
e) *Do you maintain rivet heads*	Yes.	...	Yes.

ber for partitions, flooring and interior finishing work?		out in plywood : 5-ply up to waist level, 4-ply between waist and cant rail and 3-ply for ceilings. The framing of partitions, interior, doors, mouldings, etc., in timber and runways for the metal window frames.	and roof. For interior finishing work following woods are used : 1st class mahogany. 2nd class teak. 3rd class lauan or pine. Wood partitions, flooring, door and window frames.
g) *What special steps have you taken to prevent oxidization of the metal parts?*	...	Bitumen paint used for the protection of the steel sheeting, and ample ventilation provided.	None — Rust on sheet iron plates exposed to the air is completely removed by means of sand blast and red lead is applied as a primer and then painting is carried out. Inside concealed parts painted with graphite paint. Lap joints between metals thoroughly painted with heavy coating of red lead and into space between thin plates, cotton cloth soaked with mixture of red lead and raw linseed oil inserted to prevent moisture.
h) *What classes of paint do you use on the outsides and on the insides — lacquers, cellulose, etc.?*	..	Ordinary paint and varnish for exteriors.	Outsides. — Paints and varnishes. Insides. — Varnishes. Ceiling. — White paint.
4. Interior fittings.			
a) *How have you arranged for the interior fittings of carriages with metal bodies, and the disposition of compartments, corridors, vestibules, and W. C's.?*	No details given.	No carriages entirely of steel are in use; fittings attached to wooden interior in usual manner.	Interior fittings are not different from those of wood carriages. Carriages of compartment type are built by providing through corridors to sleeping cars. Most carriages are of open berths and seats with central passages. Platform at car ends is covered *i. e.* vestibule type. Water closet is placed at each end of carriage.

QUESTION.	Argentine. (*Continued*).		China. (*Continued*)
	State Railways.	Central Argentine Railway.	South Manchurian Rys.
4.			
b) *What new problems have you had to solve as a result of metal construction of carriages, particularly in regard to :*			
1. *Ventilation.*	...	Insulation of cellular waterproof asbestos.	No difference from those of wood carriages.
2. *Heat retention.*			2 sheets of felt 12 mm. thick fitted as insulator to inside of steel plates of sheathing and roof steel sheets. Both surfaces of felt covered with asbestos paper, wrapping paper and cloth, each part being closed up by sewing to prevent separation. On floor there is a false floor of sheet metal and a compound board « Celotex » 12 mm. thickness is put into space between false floor of sheet metal and upper wooden floor board. This is effective in deadening sound and in heat retention.
3. *Heating.*			No difference from those of wood carriages.
4. *Decoration.*			No difference from those of wood carriages.
			This is covered by remarks

steps in regard to the emptying of the hoppers of W. C's.?		used.	flushing type. Trouble experienced especially in winter when hoppers are flushed with hot water causing freezing at times.
6. **Results obtained in traffic.**			
a) *How have the all-metal vehicles behaved in traffic working (i. e. have they proved satisfactory or otherwise?*	Very satisfactory.	Satisfactory.	Carriages of semi-steel have given satisfactory results and superior to old wood carriages as attention is paid to heat retention.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	Yes.	No accidents to date.	No accidents to record. No troubles such as breaking of sills, etc., experienced with wooden carriages as a result of shocks in running.
c) *What are the advantages or expense of upkeep as compared with vehicles built of timber?*	...	Cars not in service long enough to give this information but every reason to expect reduced maintenance costs. In Argentine steel has long life. Due to rigidity of steel structure and type of ballast, maintenance costs of interior fittings should be reduced.	Maintenance cost is less owing to increased strength and rigidity. Results as to rusting and corrosion not yet known.
	Note. — The Buenos Ayres Great Southern Railway and the Cordoba Central Railway, report they have no experience with steel coaches, and the Buenos Ayres and Pacific Railway consider further research necessary to save tare weight, avoid fire risks in accidents, and possible saving in maintenance charges.		

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
1. **Advantages of all-steel construction.**					
a) *Do you consider it is desirable that further researches should be made in the direction of metal (steel) vehicles?*	To consider use of non-corrosive metal not dependent on paint or other surface treatment for protection.	No.	Yes.	...	Yes.
b) *What are the reasons which justify you in this belief?*	Corrosion starting especially at joints, laps, etc. and working under the paint.	Steel cars have been built in America for a number of years, and do not consider further research necessary except in use of special alloys to reduce weight.	Experience indicates that steel coaches tend to telescope in collisions. Reduction in weight may be effected, and comfort of passengers increased.	No wooden passenger carriages in regular service. Advantage of all-steel coaches, one of safety.	Due to deterioration of steel. Investigations to find alloy more resistant and of sufficient strength. Steel is far superior to wood.
2. **Types of carriages in service, under construction or projected.**					
a) *Have you built or considered the building of metal coaches?*	Yes, only all-steel cars, built since 1911.	18 steel built in 1916 by Car Builders.	Yes.	Only steel coaches built during last 15 years.	All-metal coaches and vans in use

f America.

ew York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
No.	Yes.	Yes.	No.	Yes.	No.
perience has demonstrated advantage of steel construction. Adopted as standard by advantage of increased period of anticipated life, reduced maintenance and safety.	To get maximum strength for given weight and overcoming corrosion.	Steel cars deteriorate, principally due to rust. Investigation of non-corrosive metals having rigidity should be made. Metal cars preferred on account of increased safety and reduced maintenance cost.	Proved satisfactory over 15 years experience superior to wooden ones.	Improving materials so that weight does not become excessive. Question of finding metals which resist oxidisation and corrosion to greater extent than commercial rolled steel plate.	Except in grade of material used and kind suitable to stop corrosion.
s, all-steel standard or number of years. Improving designs gradually and reducing weight without sacrificing strength or stability.	Yes.	Yes.	For last 15 years, wooden now obsolete.	All cars built since 1915 all-steel.	All-steel cars for past 12 or 15 years.

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
b) *What is the general principle underlying their construction?*	Since 1911 cars have built-up type steel underframes of sections with plates standard angles, zee's and pressed channels. and fish-belly type centre sills and cast steel buffer beams. Body framing built up of plates, standard angles and pressed channels.	Clerestory type. 72 feet long inside, fish-belly type of underframe to carry load.	...	...	Box girder centr sill from one en to other. At tached are cant lever cross tie which suppo floor and sid frame. Carline and purline built of presse steel shapes a riveted and hel together by i tervening ste sheets.
c) *Stronger underframe with a lighter body.*	Stronger underframe and body.	...	Yes.	Strong rigid underframe with superstructure of plates riveting to angles channels and tee irons.	Strong underfran and light body
d) *Lattice-work solebars.*	...	...	Yes.	No.	No.
e) *Bulkhead tubular section, etc.*	...	...	Yes.	Bulkheads sheet steel riveted to angles.	No.
f) *Has this method of construction been applied or is it a practical proposition in regard to :*					
1. *Carriages with end doors (only).*	All coaches, have body end and, vestibule side doors.	...	No side doors are used.	Yes.	Applied to all c express, sub ban, lugga etc., with ve bule side a end doors.
2. *Carriages with side doors.*		...		Yes.	
3. *Suburban and District sets.*		...	...	...	
4. *Carriages on light railways (tramways).*		...	...	No.	

America. (*Continued*).

ew York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
h-belly type centre ills, uniform sec- ion side sills, side rame girder tied to entre sills by neans of cross bea- ers and floor sup- orts and at end vith cast steel com- ined body bolster nd platforms.	Combination of load carrying side girders and centre sills. Load comes on both the side and centre sills, centre sill load transmitted into the relatively stiff and strong side girder by transome located at intervals along length of car and in turn being carried to truck by cross bolsters connecting two-side girders.	Box girder centre sill consisting of two 18″ channels with 1/2″ × 24″ cover plates riveted on top and bottom. Box girder extends from end to end; attached are cantilevers supporting the superstructure.	Underframe fish-belly type of plate, and structural shapes, side sills, angle and « Z » bars. Belt rail and sides of plate and eaves of angle or « Z » bars.	Heavy centre sills designed as main carrying members. End framing of heavy construction. Side framing of fairly light construction. Roof carlines or pressed or rolled steel. Outside sheathing of steel plates.	...
ssed steel special ection pillars and ails.	...	Yes.	...	...	Constructed for safety and reduced maintenance rather than reduced weight.
No.	...	No.	No.	...	...
No.	...	No.	Plate and structural members.	...	...
Yes.	Yes.	Applied to all cars including end doors, both side and end doors, in heavy train service and cars in suburban services.	Yes.	Satisfactory for cars with end doors and those with side and end doors.	All main line. No suburban.
ne shewn.	Yes.		Yes.		
urban 1906. n line 1912.	...		Yes.		
...	...		Yes.		

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
3. **Process and materials of construction.**					
a) *What are the principal materials used in the construction of such vehicles. Profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Steel plates, angles, tees, channels « Z's. » contain 0.20 % copper, also use castings of steel, malleable and cast iron.	Rolled and pressed steel shaped, cast steel.	Rolled and shaped steel plates, cast steel castings, malleable iron, cast iron castings, rolled steel shapes such as angles, « I » beams, « H » beams, « Z » bars and forgings.	Steel plate with rolled sections of angles, tees and channel iron. Interior sheet steel, moulded pattern.	Heavy rolled steel shapes, such as I beams, and channels. Pressed steel shapes for carlines and purlines. Rolled steel sheets for covering or body proper. Wood only used in window sash.
b) *How do you constitute the floor of the vehicle?*	See fig. 21/6.	Floor of Flexolith composition supported by « Chanarch » steel sheets and pressed steel floor beams.	Composition laid over «Chanarch» steel plates and insulated.	« Flexolith » laid on corrugated steel.	Corrugated steel sheets fastened to cross ties upon which is laid « Monolith » magnesite flooring.
c) *Have you utilised white metals (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	No.	No.	No.	No.	No, except in making doors to get away from rust rather than reduce weight.

of America. (*Continued*).

New York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
Open hearth rolled steel bars and shapes, steel plates flat and pressed; steel castings, malleable iron castings.	Rolled sections, pressed shapes and malleable and steel castings.	Rolled sections, pressed shapes and flat sheets made of copper bearing open hearth steel, also iron castings, steel castings and malleable castings.	Structural shapes, pressed shapes, some malleable castings but mostly steel.	Open hearth steel plates and rolled shapes. Castings of cast steel preferred to gray or malleable iron. Light plates pressed to pattern used for interior finish.	Heavy steel castings. Plates plain and flanged; shapes such as angles, channels, etc.
Monolithic composition laid on « Chanarch » carried on longitudinal stringers built into underframe construction. Metal false floor fully insulated below main floor.	Flexible composition laid in a plastic condition over steel plates.	One layer of corrugated or shaped steel covered with 3/4″ magnesite cement flooring.	Steel plate with « Chanarch » sheets on top covered with « Flexolith ».	Surfaced with 5/8″ thick red mastic cement (« Flexolith») compound. No. 22 gauge galvanised pressed floor plates on top of underframe. A 3/32″ sub-floor of copper bearing steel secured to underside of floor structure, inside surface of sub-floor carries floor insulating material.	Fire-proof composition laid over galvanised steel sub-floor.
No.	No.	Experimented with different grades of aluminium for superstructure of a few cars in suburban service.	No, considering aluminium copper alloys.	Aluminium for interior finish of gas-electric rail cars to reduce weight.	No.

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
d) *What methods of assembly have you adopted. Riveting, oxy-acetylene welding or electric arc or spot welding?*	Rivets used for all frame members, electric welding used for doors, partitions and inside side and end finish.	Riveting.	Riveting, oxy-acetylene welding, electric welding and spot welding. Riveting is employed in framework.	Principally riveting; some parts welded by oxy-acetylene electric, or spot welding.	Mainly riveted together although roof sheets and some light sections are welded — both oxy-acetylene and electric arc welding used.
e) *Do you maintain rivet heads on the outside of the vehicles?*	Yes.	Yes.	Yes.	Yes.	Yes, practically all rivets have round heads, exposed to view on outside.
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	Not used.	No timber used.	*Through passenger cars*, timber is used for arm rests, windows, sash and window sills, metal sash will be used on future equipment. *Suburban cars*, timber used for window sills, and sash. On last 150 suburban cars brass sash was used. *Baggage and express cars*, timber used for flooring, fish racks and door guards. *Mail cars*, timber used for flooring and some fittings such as tables and stanchions.	No wood used for these purposes.	No wood usec except for win dow sash, doors partitions of steel.
g) *What special steps have you taken to prevent oxidisation of the metal plates?*	Steel of 0.20 % copper bearing content.	All metal parts are covered with preservative paint.	Steel framing and inside of outside sheathing given a protective coating of red lead primer or car cement.	In plates subject to oxidisation, *i. e.* roof sheets, copper content steel used.	Use steel sheet co taining 1/4 copper. All ste surfaces covere with red lea paint or othe protective prim and regular co enamel.

f America. *(Continued)*

ew York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
eting roof sheet oints; electric-arc velded, oxy-acety- ene and electric ırc welding for niscellaneous weld- ng operations; spot velding on thin olate and sheet teel work.	Mostly riveting; have used oxy-acetylene and electric arc welding processes.	Riveting together. Oxy-acetylene, electric arc welding and spot welding used to a limited extent.	Riveting, some acetylene and arc welding.	Principally riveting. Welding by oxy-acetylene, spot and electric arc processes, partially.	Rivets in heavy metals and acetylene and electric welding on lighter metals.
ll rivet heads on xterior.	Yes.	Practically all rivets have round heads exposed outside.	Yes.	Yes.	Yes.
od used to very imited extent in assenger coaches or seat arm rests, vindow sill mould- ngs, and window ash. On coaches nder construction vood further res- ricted by substitu- ion of brass sash.	Window sills, inside doors and seat arms.	No wood used for partitions, flooring or finish.	All parts are steel except window sash, window sills, and doors.	Only for doors, window sash and trim.	None — using steel partitions, doors and interior finish.
rough sandblast- ng of all metal arts before paint- ng, metal protect- ng paints and acid esisting protectors n parts most sub- ect to corrosion. lso copper bearing teel for roofs.	Plates sandblasted and coated with red lead before painting.	Use of copper bearing steel which is open hearth steel containing 1/4 % copper and all parts thoroughly cleaned and coated with protective paint.	All interior or hidden surfaces are coated with red lead paint.	Sandblasting to remove scale and grease, first coat of paint inside and out of red lead and linseed oil. Copper bearing steel plates used to some extent.	None.

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
h) *What classes of paint do you use on the outsides and on the insides — lacquers, cellulose, etc.?*	Enamel finish interior and exterior covered with varnish. Some of the modern cars have lacquer exterior finish.	Varnish inside and outside. No lacquers used.	Lacquers are of recent use in U. S. A. Experimental applications have been made. Previously standard practice was to use enamel on outside of suburban cars and varnish on outside of through line coaches also interior of through line and suburban coaches.	Outside « Duco », a form of lacquer. Insides — Paint and varnish.	Most cars paint[ed] inside and o[ut] with oil pain[t] or enamels a[nd] varnished. E[x]perimenting wi[th] cellulose prepar[a]tions.
4. Interior fittings.					
a) *How have you arranged for the interior fittings of carriages with metal bodies, and the disposition of compartments, corridors, vestibules, & W. C's.?*	...	...	...	Interior fittings, secured by machine screws.	Interior partitio[ns] of sheet ste[el] either riveted [to]gether or asse[m]bled by machi[ne] screws; th[e] partitions [are] attached direc[t] to post of [the] frame.
b) *What new problems have you had to solve as a result of metal construction of carriages, particularly in regard to :*					
1. *Ventilation.*	Exhaust ventilators in upper deck. Some modern cars also have intake ventilators below window sash.	Exhaust type of ventilators.	Deck ventilators. Roof ventilators over and bell ventilators under toilets.	No difficulties.	None.

of America. (*Continued*).

New York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
Steel car primers, surfacers, finishing paint (colour coach) and varnished outside and inside of body. Lacquer used on limited number of cars for test purposes.	*Exteriors.* Oil paints and varnishes used to great extent. In some cases have used lacquer finishes. *Interiors.* Oil paints and varnishes.	Oil paints on both inside and outside. Experimenting with lacquers for both inside and outside.	Up to short time ago all paints used on outside were oil. Now using lacquer paints such as « Duco », etc. Inside paint is oil.	Oil paints and varnish generally used. Several cars recently finished with cellulose lacquers inside and outside.	Asphaultum cement and red lead on underframes and underside of all sheets. Ordinary paint for exterior and interior painting.
Interior finish, trim and all partitions of built up steel construction, interiors arranged with all fittings (seats, parcel racks, etc.), in one main compartment.	...	All interior fittings including partitions for compartments, corridor vestibules, etc., built up of steel plates 1/16″ thick, and riveted in place.	Same layout as under old time wooden construction	Arranged with centre aisle and two passenger transverse seats on either side of aisle, smoking compartment provided at one end, W. C's. located at each end.	Practically as in wooden cars.
Approximately same as wooden cars in regard to intakes and exhausts.	None — use screens and roof ventilators and in some cars air is kept in motion by electric fans.	Intake system same as on wooden cars. Air taken at roof at each corner and carried under the floor over heating pipes through the car.	Automatic exhaust ventilators or deck sash.	Obtained by upper deck ventilators and vertical circulating electric fans. Vertical exhaust fans with roof ventilators in smoking compartment. W. C's. have small window sash ventilators in addition to deck ventilators.	...

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
2. *Heat retention.*	Insulating under side of exterior surface and back of interior finish.	Insulation applied to cars will help to retain heat in winter and exclude heat in summer. Also acts as deadener.	Insulated on sides ends, under floor and under roof.	Insulated (hair felt or similar material) applied between sheets on sides, ends and roof.	Found necessary t add an insulat ing blanke (3/4″) to insid of outer sheet.
3. *Heating.*	Steam vapour heat Some modern cars also have thermostat heat control.	See 2 above.	Heated with vapour system, and recent cars have both thermostatic and manual control.	No comments.	None.
4. *Decoration.*	Side and end interior finish grained to represent mahogamy. Ceiling cream colour striped with green while pilasters on side finish have satin stripes.	...	No interior decoration other than paint and enamel.	No difficulties.	Plain finished in terior of one c two colours c enamel — change from va nish natura wood finish.
5. *Noise prevention.*	Packing between interior finish and framing, also rubber below body centre plates, side bearings, platform buffers, etc.	See 2 above.	Floors are insulated and lever guides have wood strips to prevent noise. All pipes are securely clamped to prevent vibration.	No difficulties.	Insulating blank to inside outer sheet dea dens sound.
c) *Have you taken any special steps in regard to the emptying of the hoppers of W. C's.?*	Standard practice to discharge flush hoppers on right of way.	Flush hoppers used with gravity system.	In through line service flush hoppers are used and dry hoppers in suburban service. Reason for use of dry hoppers is that they are seldom used in suburban service and cost and maintenance much less than flush hoppers. No special provision made for emptying contents.	No special steps taken.	Use dry hoppe W. C's. lock whilst cars stations. Hoppe drop contents road while c in motion.

f America. (*Continued*).

ew York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
mplete insulation of walls, roof and floor with layers of hair felt and asbestos 1/4" to 3/4" thick, also weather stripping round all doors and windows.	None — heat retention is accomplished by use of insulating materials between inner and outer sheathing of the cars.	Insulation used on outside of inside lining.	« Salamander » hair felt insulation.	Afforded by use of insulating material secured to back of outside sheathing of car body. Floor and roof also insulated.	Ample insulation on the inside of all sheets.
pproximately same amount of heat radiating surface for heating units as wooden cars.	None — supplied from locomotive.	About 20 % more heating surface required than wooden cars.	Steam-vapour system on late cars.	Steam heating used except on gas-electric cars where hot water used.	...
at colours with striping or wood graining effects on interiors. Dark olive green with gold leaf lettering on exteriors.	None — grained mahogany.	Interiors painted with plain colours. Very few decorations used.	Painted instead of inlay and varnish.	Passenger coaches decorated with gold stripes. Dining cars with gold stripes, figures, etc., in addition to decorative colour painting, lights and fans.	...
sulation of walls, roof and floor also acts as noise deadener.	None — largely a matter of maintaining tight joints in car structure.	False floor placed under main floor to act as air conduit for ventilating, this with insulation reduces noise.	No trouble.	Type of floor used and insulation prevent noise, more quiet than cars built of wood.	...
— flush hoppers discharge direct to outside.	No — except when trains are standing in stations in which case buckets or cans provided.	W.C's. flushed with water on main line cars. Dry closets suburban cars, W.C.'s locked at stations.	Dry hoppers on older equipment. « Duner » flush hoppers on new equipment.	All W. C's. of water flush type. Both pressure and gravity water system used, former preferable.	Flush hoppers hand operated.

QUESTION.	United States				
	Baltimore & Ohio.	Delaware & Hudson.	Erie.	Lehigh Valley.	Long Island.
5. **Results obtained in traffic?**					
a) *How have the all-metal vehicles behaved in traffic working, i. e. have they proved satisfactory or otherwise?*	Cars have behaved very satisfactorily to the extent that they reflect no looseness in construction from service, and eliminate entirely all creaking of structure formerly experienced with wood constructed car equipment.	Yes — satisfactorily.	Yes — satisfactorily.	Proved satisfactory.	Satisfactorily.
b) *Have you obtained any information as to their behaviour when they met with accidents or collisions?*	In accidents our all-metal equipment has provided safety as they withstand distortion from shocks much more than wood constructed cars and not inflammable like such equipment.	Very well.	No serious accidents or collisions in which steel coaches involved; a few derailments in which steel equipment next to locomotive protected remainder of train.	ot damaged as seriously as wooden cars.	Special advanta in a wreck, they present fire hazard an hold togeth better than wo den cars.
c) *What are the advantages or expense of upkeep as compared with vehicles built of timber?*	We have no details as to the difference in cost of upkeep but they do provide longer service in better condition between shopping periods than wood constructed cars.	No figures available.	Cars which have not been in accidents only require painting every 18 months, also incident repairs to trucks, such as new brasses, repacking, etc. running repairs to brakework, draft and buffing gear. Wooden cars develop creaks. In addition to above wooden structure may rot and roofs have to be well cared for.	Upkeep less than wooden cars and superior from safety standpoint.	Upkeep less th wooden cars an repairs when n cessary are che per and more s tisfactory.

of America. (*Continued*).

New York Central.	Norfolk & Western.	Pennsylvania.	Reading.	Richmond, Fredericksburg & Potomac.	Wabash.
Satisfactorily.	Satisfactorily.	Satisfactorily.	Very satisfactorily, only possible adverse effect increased operating cost due to greater weight and higher degree of track maintenance where sharp curves located. Advantages far outweigh disadvantages.	Satisfactorily.	Satisfactorily.
Superior to wooden cars when in accidents or collisions both as regards resistance to damage and fire.	Records show that in accidents or collisions steel cars are damaged much less than wooden cars, and fewer passengers suffer injury.	In accident or collision, steel cars present no fire hazard, are damaged to much less extent than wooden cars and have materially reduced injury to passengers.	Far safer than wood and elimination of fire hazard and reduction in loss of life or injury to passengers and employees in accidents involving steel cars as compared with cars of wooden construction, afford all necessary proof of advantages of all-steel construction.	Much stronger than wooden cars; they are not damaged to the extent that wooden cars would be when in collisions or accidents and are fireproof to a much greater extent.	Damaged much less.
Maintenance costs for all-steel cars are somewhat less than for wood, or steel underframe equipment. Require few repairs beyond wheel and axle work on trucks — slight attention to interior fittings and furnishings and interior and exterior finish. Some 17-year old coaches only required certain roof repairs and in some cases partial renewal. Design now improved and those now being built will have longer life.	Very little difference. When cars are new, there is a decided advantage on side of steel car but average through life is about the same.	Less than wooden cars for same service performed.	More modern — gives longer life and safety. No comparative figures on upkeep but may probably be less on steel equipment in proportion to weight of car and number of passengers carried. Increased cost of steel car upkeep probably caused by higher labour and material costs than were in vogue when wooden cars were built — wood being sold or scrapped.	Do not deteriorate as readily as wooden cars, do not require as extensive repairs and remain out of repair-shops for longer periods.	Expense of upkeep lighter.

QUESTION.	Great Britain.			
	London Midland and Scottish Railway.	London and North Eastern Railway.	Metropolitan Railway.	Underground Electric Railways Company of London.
1 **Advantages of all-steel construction.**				
a) *Do you consider it is desirable that further researches should be made in the direction of metal (steel) vehicles?*	Yes.	Yes.	Yes.	Yes.
b) *What are the reasons which justify you in this belief?*	To find means of reducing first cost, maintenance and tare weight. Also review possibility of using metals to resist corrosion to a greater extent and determine suitable thickness of panelling.	Steel heavier and more costly. Further research to obtain reduction in weight and cost.	Every effort should be made to reduce first cost and also running weight.	Corrosion.
2 **Types of carriages in service, under construction or projected.**				
a) *Have you built or considered the building of metal coaches?*	Yes — have a number already in service.	119 carriages: K. C. . . . . . 3. Open third . . . 21. Lugg. brake van 34. Semi - open . . 1. Comp. rest . . 3.	Very few built. . .	Yes — building.

construction?	girder, *i. e.* top member is roof and bottom member is underframe. Main body framing of pressings and rolled steel sections — Side Panelling is of 0.080" thick, M. S. plates lead coated. Roof consists of galvanised plates 0.064" — Special rolled section acts as rain guttter — cant rail, and connects body and roof together.	underframe and rolled sections. Latest special sections. Framing of open thirds — series of complete ribs, etc.		as a whole.
c) *Stronger underframe with a lighter body.*	...	Underframe lightened because of strength of body.	...	Combined strength of body and underframe permits of lighter sections being used.
d) *Lattice-work solebars* .	No.	No.	...	
e) *Bulkhead tubular section, etc.*	No.	No.	...	...
f) *Has this method of construction been applied or is it a practical proposition in regard to:*				
1. *Carriages with end doors (only).*	Vestibule stock. . .	...	...	Carriages with side and end doors.
2. *Carriages with side doors.*	Yes.	...	...	
3. *Suburban and District sets.*	Yes.	...	...	...
4. *Carriages on light railways (tramways).*	...	...	...	...

QUESTION.	Great Britain. (*Continued.*) London Midland and Scottish Railway.	London and North Eastern Railway.	Metropolitan Railway.	Underground Electric Railways Company of London.
3 **Process and materials of construction.**				
a) *What are the principal materials you have used in the construction of such vehicles, profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Underframe — rolled steel sections and plates. Main body framing — pressed and rolled steel section. Paneling and roofing—mild steel and galvanised sheets.	K. cars — Rolled angles and tees profiled. Charcoal finished cold rolled panels. Roof exterior with mild steel, roof plates with cotton duck as outer covering.	Framed with steel angles and channels and covered thereafter with flat steel plates.	Profiled steel sheets riveted to light pressed and rolled steel sections.
b) *How do you constitute the floor of the vehicle?*	« Chanarch » or « Keystone » corrugated sheeting covered with « Decolite », « Flexolith » or « Induroleum ».	Steel plates (or corrugated steel sheets) galvanised both sides and covered on top with asbestos composition.	Corrugated steel with fireproof composition.	Light steel plates covered with wooden floor slats.
c) *Have you utilised light metal (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	Alloy steel for underframe members or all-steel (classification 3-A) electric carriages — also aluminium for interior fittings.	Aluminium alloys for seat ends in open thirds and rail cars.	No.	Aluminium alloys for passenger doors and interior fittings. Wood doors in some cases with or without metal sheathing.
d) *What methods of assembly have you adopted. Riveting, oxy-acetylene welding or electric arc or spot welding?*	Riveting.	Kitchen cars — body pillars consisting of angle bent to shape. Carlines of tee section also covering sheets fixed by soft iron cold rivets, plates being punched into countersunk holes on the framing. Finish flush being cupheaded on inside of framing.	Riveting.	Riveting.

the vehicles?				moulding.
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	Interior furnishings on vestibule carriages.	Kitchens — ordinary timber partitions covered with steel plates. Timber used for finish.	All partitions, doors, seats and mouldings.	Interior mouldings of timber, also wood fittings bolted to main framing for securing interior panelling and mouldings in position.
g) *What special steps have you taken to prevent oxidisation of the metal plates?*	By cleaning prior to painting.	*Kitchen cars* — Interior sides and roof were painted with anti-corrosion paint. *Open thirds and B. vans.* Air space between outer and inner linings of sides and roofs.	Several coats of red lead paint.	Priming coats of special graphite paint or experimental use of copper bearing steel.
h) *What classes of paint do you use on the outsides and on the insides — lacquers, cellulose, etc.?*	Ordinary oil paints.	Ordinary oil paints.	Oil paint and varnish inside and out.	Exterior — paint and varnish. Exposed interior panels — paint and varnish; Exposed interior woodwork — paint or varnish finish.
4 Interior fittings.				
a) *How have you arranged for the interior fittings of carriages with metal bodies, and disposition of compartments, corridors, vestibules and W. C.'s?*	In all-steel (classification 3-A) carriages, fittings attached by means of set screws and specially shouldered bolts to metal framing. On vestibule carriages (classification 3-B) partitions and fittings fixed to hard wood or wood fibre fillets inserted in metal body framing, floors and roofs.	As in wooden cars.	As in wooden coaches.	Lamp fittings, hand grip brackets, etc. screwed to timber fittings bolted to framing (no W. C's).

QUESTION.	Great Britain. (*Continued.*) London Midland and Scottish Railway	London and North Eastern Railway.	Metropolitan Railway.	Underground Electric Railways Company of London.
h) *What new problems have you had to solve as a result of metal construction of carriages, particularly in regard to :*				
1. *Ventilation*	No.	Torpedo in roof, glass louvre or sliding shutter in compartments, and drop lights in doors.		...
2. *Heat retention*	Heating surface increased. — Insulation used.	No insulation . . .	No particular problems have arisen.	...
3. *Heating*		...		...
4. *Decoration*	As on wood cars. .	Ordinary		...
5. *Noise prevention* . . .	No difficulties . . .	No insulation . . .		Rubber pads fitted to side springs and bolster springs on bogies. Asbestos sheets lining seat risers over wheels and asbestos sheet between floor plates, and wood slats side panels lined with canvas.
c) *Have you taken any special steps in regard to the emptying of the* [illegible]	No.	Flush hoppers . . .	...	None required.

Results obtained in traffic.				
a) *How have the all-metal vehicles behaved in traffic working (i. e. have they proved satisfactory or otherwise)?*	Satisfactory . . .	Satisfactory	Yes.	Yes.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	Steel carriages (classification 3-B.) stood up well.	No accidents. . . .	Only accidents have been due to rough shunts.	Less danger of injury to passengers.
c) *What are the advantages or expense of upkeep compared with vehicles built of timber?*	Not sufficient time in traffic to compare maintenance costs.	K. C. 14 years old. No expense beyond what would have been met with in timber except floor renewals, and possibly some body panel plates shortly.	Not sufficient experience but all-metal coach seems to be more expensive in upkeep.	...

Note. — The *Great Western Railway Company* consider that it is desirable to make research into the cost of construction, weight and strength, and also resistance to fire, but have only built one experimental all-steel carriage.

The *Southern Railway* also support the view that further research is necessary to ascertain if such coaches ensure greater safety for passengers in cases of accidents, and also from point of view of maintenance costs.

QUESTION.	Africa.			
	Gold Coast Government Railways	Nigerian Railway.	South African Railways and Harbours.	Sudan Government Railways and Steamers.
1 **Advantages of all-steel construction.**				
a) *Do you consider it is desirable that further researches should be made in the direction of metal (steel) vehicles?*	Yes.	No steel coaches . .	No opinion expressed as only 13 steel coaches.	Yes.
b) *What are the reasons which justify you in this belief?*	Should be possible by extensive use of steel and alloys to economically produce and maintain a standardised type of vehicle having a much lower tare ratio per passenger.	...	Remarks that teak is only suitable timber for frame-work and cost is going up.	To ascertain definitely whether a more durable and economical type of vehicle can be evolved.
2 **Types of carriages in service, under construction or projected.**				
a) *Have you built or considered the building of metal coaches?*	Yes.	Now on order from England.	13 in traffic were imported; not considered building in South Africa.	...
b) *What is the general principle underlying their construction?*	...	Steel angles replacing roof sticks, side pillars and bottom sides.	Underframes on cantilever principle — B. S. S. sections.	...
c) *Stronger underframe*	Light body	Yes.	...	...

e) *Bulkhead tubular section, etc.*	No.	No.	...	...
f) *Has this method of construction been applied or is it a practical proposition in regard to :*				
1. *Carriages with end doors (only).*	End doors only. . .	Yes.	...	...
2. *Carriage with side doors.*	...	Yes.	...	...
3. *Suburban and District sets.*	...	Yes.	...	...
4. *Carriages on light railways (tramways).*	...	No.	...	...
3				
Process and materials of construction.				
a) *What are the principal materials you have used in the construction of such vehicles. Profiled and shaped sheet iron plates, steel plates, moulded to pattern, stamped sheet iron plates, malleable cast iron?*	Profiled and shaped steel sheets.	No information available.	Profiled and shaped steel plates. Underframe details in cast steel. No malleable iron used.	...
b) *How do you constitute the floor of the vehicle*	Corrugated « Keystone » section steel sheet and floor made with proprietary asbestos cement compound.	Dovetailed steel flooring laid over with « Decolite ».	Framed deal flooring.	..
c) *Have you utilised light metal (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	No.	No.	No.	..

QUESTION.	Africa. (*Continued.*)			
	Gold Cost Government Railways	Nigerian Railway.	South African Railways and Harbours.	Sudan Government Railways and Steamers.
d) *What methods of assembly have you adopted. Riveting oxy-acetylene welding or electric arc or spot welding?*	Riveting	Riveting	Riveting	...
e) *Do you maintain rivet heads on the outsides of the vehicles?*	Yes.	No.	Both systems in use.	...
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	Doors proper, windows and small miscellaneous packings and mouldings (not for partitions and floors).	No information available.	1 coach: floors, partitions and finishings. 12 coaches: floors, door frames, door slams and furniture.	...
g) *What special steps have you taken to prevent oxidisation of the metal plates?*	Steel sheets lead coated.	Outside plates lead coated.	...	...
h) *What classes of paint, do you use on the outsides and on the insides — lacquers, cellulose, etc.?*	Outside — two ground paints and two enamel. (Inside — one oxide when required).	Exterior — locally made ground colours with enamel and varnish for final coasts. Interior — enamel.	Outside of body coated with brown enamel painted and grained; woodwork varnished.	...
4 **Interior fittings.** a) *How have you arranged for the interior fittings of carriages with metal bodies, and disposition of compartments, corridors, vestibules and W. C's.?*	Open coaches with central gangway. W. C's. self-contained in centre and at side.		Interior furnishings and metal fittings (oxidised copper relief) fixed to steel members by thread screws by tapping, or nuts are used, if material is not of	...

result of metal construction of carriages, particularly in regard to:	None.	No information available.		
1. *Ventilation*				...
2. *Heat retention*			Consideration will be given to lining with asbestos. At present do not compare favourably, being very hot in summer, and very cold in winter.	...
3. *Heating*			Vapour — experiment.	...
4. *Decoration*			...	...
5. *Noise prevention*			...	...
c) *Have you taken any special steps in regard to the emptying of the hoppers of W. C's.?*	No hoppers	No.	Trap actuated from flushing cistern lever.	...
6 **Results obtained in traffic.**				
a) *How have the all-metal vehicles behaved in traffic working (i. e. have they proved satisfactory or otherwise)?*	Yes.		Not satisfactory. Noisy — do not ride so smoothly as wooden coaches. More susceptible to changes in temperature.	Fair satisfaction. In tropical country slightly warmer, shrinkage on wood (internal) more pronounced on metal than on timber.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	No.	No experience yet.	No.	Yes — two coaches burnt out and having no independent underframe salvage restricted to bogie only.
c) *What are the advantages or expense of upkeep compared with vehicles built of timber?*	No accurate information available.		Removal and replacing fittings more costly than timber but steel coaches do not require such heavy repairs as timber vehicles. Steel (wood lined) coaches preferable to all-steel.	Not definitely ascertained but anticipate metal will be less than wood in upkeep.

QUESTION.	Australasia. New South Wales Government Railways.
1	
Advantages of all-steel construction.	
a) *Do you consider it is desirable that further researches should be made in the direction of metal (steel) vehicles?*	Yes.
b) *What are the reasons that justify you in this belief?*	More noise and heat than with wooden cars. Deterioration due to corrosion.
2	
Types of carriages in service, under construction or projected.	
a) *Have you built or considered the building of metal coaches?*	Yes.
b) *What is the general principle underlying their construction?*	Combined body and underframe. Sides of body carry part of load.
c) *Stronger underframe with a lighter body.*	...
d) *Lattice-work solebars*	No.
e) *Bulkhead tubular section, etc.* . .	Bulkhead of single plates stiffened with angles.
f) *Has this method of construction been applied or is it a practical proposition in regard to:*	
1. *Carriages with end doors only.* . .	...
2. *Carriages with side doors.* . . .	...
3. *Suburban and District sets.* . . .	Suburban electric cars.
4. *Carriages on light railways (tramways).*	...

QUESTION.	Australasia. (*Continued.*) New South Wales Government Railways.
3 **Process and materials of construction.**	
a) *What are the principal materials you have used in the construction of such vehicles, profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Profiled and sheet steel plates with pressed sheet steel ends. Framework of steel pressings.
b) *How do you constitute the floor of the vehicle?*	Sub floor key pattern, sheet steel galvanised. Layer of compressed cork 1/2″ thick on top 1/4″ linoleum for passenger cars. Parcel van underframe covered with sheet steel plates 1/8″ thick with wooden floor boards above.
c) *Have you utilised light metals (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	Doors of aluminium silicon alloy and aluminium copper alloys cast in one piece.
d) *What methods of assembly have you adopted. Riveting, oxy-acetylene welding or electric arc or spot welding?*	Riveting.
e) *Do you maintain rivet heads on the outsides of the vehicles?*	Yes, except in moulding (csk. flush).
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	*Passenger cars.* — Window sills, louvre blinds, and a few packings wood. *Parcel vans.* — Sides lined with wood sheathing.
g) *What special steps have you taken to prevent oxidisation of the metal plates?*	*Exterior.* — Body sheathing partition plates and framework pressings are lead coated plates. *Interior.* — Whole structure red oxide during construction.
h) *What classes of paint do you use on the outsides and on the insides — lacquers, cellulose, etc.?*	*Priming.* — Mixed red oxide and black japan. *Finishing coats.* — Enamel paint.

QUESTION:	Australasia. (*Continued.*) New South Wales Government Railways.
4	
Interior fittings.	
a) *How have you arranged for the interior fittings of carriages with metal bodies, and the disposition of compartments, corridors, vestibules and W. C's?*	Finishing generally in steel but wood glass frames.
b) *What new problems have you had to solve as a result of metal construction of carriages, particularly in regard to:*	
1. *Ventilation*	No.
2. *Heat retention*	No.
3. *Heating*	No.
4. *Decoration*	No.
5. *Noise prevention*	Inside sheathing backed with baize to prevent drumming and cork floors tend to reduce noise.
c) *Have you taken any special steps in regard to the emptying of the hoppers of W. C's?*	No.
6	
Results obtained in traffic.	
a) *How have the all-metal vehicles behaved in traffic working, (i. e. have they proved satisfactory or otherwise)?*	Satisfactory.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	No accidents or collisions.
c) *What are the advantages or expense of upkeep compared with vehicles built of timber*	Not sufficient experience.

QUESTION.	Canada. Canadian National Railways.
1	
Advantages of all-steel construction.	
a) *Do you consider it is desirable that further researches should be made in the direction of metal (steel) vehicles?*	Yes.
b) *What are the reasons which justify you in this belief?*	Possible use of copper bearing steel or aluminium to prevent corrosion reduce weight and add greater strength.
2	
Types of carriages in service, under construction or projected.	
a) *Have you built or considered the building of metal coaches?*	Yes. — All-steel exterior with wood interior since 1914.
b) *What is the general principle underlying their construction?*	Continuous self supporting steel underframe, fish-belly type and steel superstructure and sheathing.
c) *Stronger underframe with a lighter body.*	...
d) *Lattice-work solebars*	No.
e) *Bulkhead tubular sections, etc.* . .	No.
f) *Has this method of construction been applied or is it a practical proposition in regard to :*	
1. *Carriages with end doors only.* . .	Yes.
2. *Carriages with side doors.* . . .	No.
3. *Suburban and District sets.* . .	Yes.
4. *Carriages on light railways (tramways)*	Yes.

QUESTION.	Canada (*Continued.*) Canadian National Railways.
3	
Process and materials of construction.	
a) *What are the principal materials you have used in the construction of such vehicles. Profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Steel plates, structural shapes, pressings — no malleable used except for fittings.
b) *How do you constitute the floor of the vehicle?*	1/16″ steel plate. Roofing papers 2 layers « Salamander » roofing paper. Lower floor 13/16″ T. & G. laid diagonal roofing paper. Top floor 13/16″ T. & G. laid longitudinal.
c) *Have you utilised light metals (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	No.
d) *What methods of assembly have you adopted, riveting, oxy-acetylene welding, or electric arc or spot welding?*	Riveting.
e) *Do you maintain rivet heads on the outsides of the vehicles?*	Yes.
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	All interior woodwork, floors, partitions, doors.
g) *What special steps have you taken to prevent oxidisation of the metal plates?*	Use of copper bearing steel, also sandblasting; priming.
h)) *What classes of paint do you use on the outsides and on the insides lacquers, cellulose, etc.?*	...

QUESTION.	Canada. (*Continued*) Canadian National Railways.
4. **Interior fittings.**	
a) *How have you arranged for the interior fittings of carriages with metal bodies, and the disposition of the compartments, corridors, vestibules and W. C's.?*	Cars wood lined. Passage ways and rooms formed by built up wooden partitions.
b) *What new problems have you had to solve as a result of metal construction of carriages, particularly in regard to:*	
1. *Ventilation*	Exhaust type.
2. *Heat retention*	« Salamander » insulation.
3. *Heating*	Vapour.
4. *Decoration*	Natural wood finish.
5. *Noise prevention*	Insulation prevents noise.
c) *Have you taken any special steps in regard to the emptying of the hoppers of W. C's.?*	No.
6 **Results obtained in traffic.**	
a) *How have the all-metal vehicles behaved in traffic working, (i. e., have they proved satisfactory or otherwise)?*	Satisfactory.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	...
c) *What are the advantages or expense of upkeep compared with vehicles built of timber?*	...

QUESTION.	Bombay, Baroda & Central India.	Eastern Bengal.
1.		
Advantages of all-steel construction.		
a) *Do you consider it is desirable that further research should be made in the direction of metal (steel) vehicles?*	Yes.	Yes.
b) *What are the reasons which justify you in this belief?*	Existing coaches unduly heavy and susceptible to corrosive influences. Aluminium and copper alloys likely sources of fruitful experiment and research.	Experience not satisfactory. Corrosion due to rust in damp climate of Bengal.
2.		
Types of carriages in service, under construction or projected.		
a) *Have you built or considered the building of metal coaches?*	No — built by Cammell Laird's.	Yes — not considering any more at present.
b) *What is the general principle underlying their construction?*	Body and underframe integral.	Box formation of underframe and steel body obtaining stability without use of heavy section members in underframe.
c) *Stronger underframe with a lighter body.*	...	...
d) *Lattice-work solebars . . . .*	...	...
e) *Bulkhead tubular section, etc. . .*	...	...
f) *Has this method of construction been applied or is it a practical proposition in regard to :*		
1. *Carriages with end doors only . . .*	...	No.
2. *Carriages with side doors. . . . . .*	...	Yes.

ndia.

East Indian.	Great Indian Peninsula.	North Western.	South Indian.
Not sufficient experience.	Yes.	Yes.	No opinion offered.
...	Acute shortage of timber anticipated next few years. Efficient substitute wanted.	Increase in cost of teak and reduction in repair costs.	...
...	Yes — built in 1914, 1922, and 1926/27 (180).	Obtained from England.	Obtained from England.
...	Adequate underframe with superimposed steel shell.	Underframes usual channel section with cross bracings.	Strong underframe.
...	Suburban stock 68' 0" x 12' 0" built on strengthened underframe as replacement of standard trussing, but not to lighten body.	...	Steel curb angle side sills. Stronger section channel iron inner longitudinals and braced angle iron cross stays secured by angle iron knees.
...	...	...	No.
...	...	...	No.
...	...	...	...
...	...	...	Sliding side doors.

QUESTION.	India. Bombay, Baroda & Central India.	Eastern Bengal.
3. *Suburban and District sets.*	Yes.	...
4. *Carriages on light railways (tramways).*	...	...
3.		
Process and materials of construction.		
a) *What are the principal materials you have used in the construction of such vehicles, profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Steel plates pressed to pattern.	Profiled and shaped shee iron plates, stamped shee iron plates and steel pla tes pressed to pattern.
b) *How do you constitute the floor of the vehicle?*	Composition on dovetailed galvanised sheeting.	« Decolite » laid on flange or dovetailed steel sheet
c) *Have you utilised light metals (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	Aluminium alloy for doors (« Alpax »).	No.
d) *What methods of assembly have you adopted, riveting oxy-acetylene welding or electric arc or spot welding?*	Mainly riveting but some arc or gas welding.	Riveting.
e) *Do you maintain rivet heads on the outsides of the vehicles?*	No.	Yes.
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	Timber for lower class seats and interior finishing except roofs whereon asbestos millboard used.	No wood in partitions, onl used in seat framing, backs upper bunks, door stile pillars, and glass frames.
g) *What special steps have you taken to prevent oxidisation of the metal plates?*	None, except paint and oil varnishing at regular intervals.	All joints treated with coat ing of red lead.

(Continued.)

East Indian.	Great Indian Peninsula.	North Western.	South Indian.
...	...	...	...
...	...	...	...
...	Bogies of pressed steel sections on underframes of rolled steel sections.	Not stated.	Body pressed channel shaped steel pillars, riveted to curb sill at bottom, and T. & L. section cant rails at top, waist and quarter panels, steel sheets riveted to pillars.
...	Asbestos cement on key pattern sheeting.	Composition similar to « Decolite » — on dovetailed steel.	Galvanised steel (dovetailed section) 18 S. W. G. and composition (« Decolite » or « Induroleum »).
...	No.	No.	No.
...	Riveting.	Assembled in England.	Hand riveting.
...	Flush finish.	Yes.	Both head and flush, as necessary.
nterior.	All linings, seats. etc., ceilings of asbestos sheeting.	Interior body of wood.	Battens for seats, parcel racks, and cushioning. Dovetailed floor plates, internal lining, filling in pressed channel pillars. Door framing and light mouldings in interior.
...	Metal plates protected on inside by bituminous paints. Outside only oil paints and varnish.	Painted.	Metal plates painted with red lead on inside between joint. Inside and outside painted.

QUESTION.	India. Bombay, Baroda & Central India.	India. Eastern Bengal.
h) *What classes of paint do you use on the ousides and on the insides — lacquers, cellulose, etc.?*	Paint and oil varnish.	Ordinary lead base both inside and outside.
4.		
Interior fittings.		
a) *How have you arranged for the interior fittings of carriages with metal bodies, and the disposition of compartments, corridors, vestibules and W. C's?*	...	No special fittings necessary except seating and bunks. Bunks suspended from brackets riveted to roof and hinged to pillars. No vestibules or corridors; compartments are full width of coach. Lavatories half width. Partitions fixed to roof with 1 $^1/_2$" × 1 $^1/_2$" × $^1/_8$" steel angles.
b) *What new problems have you had to solve as a result of metal construction of carriages particularly in regard to:*		
1. *Ventilation*	None.	Torpedo.
2. *Heat retention*	None.	...
3. *Heating*	None.	...
4. *Decoration*	None.	...
5. *Noise prevention*	None.	...
c) *Have you taken any special steps in regard to the emptying of the hoppers of W. C.'s?*	...	C. I. floor pans with projecting chutes standard practice for India.

Continued.)

East Indian.	Great Indian Peninsula.	North Western.	South Indian.
...	See 3 (g). No lacquer or cellulose on steel stock, but on wood, was failure.	Ordinary paint.	Ordinary oil paints.
...	...	Shell - steel. Interior - wood.	...
...	No troubles as coaches run with windows open.	...	« Monarch Rapid Exhaust » roof type. Sufficient wide windows and electric fans in upper class carriages.
...	See 4-b)-1.	None.	Non-conducting linings of asbestos millboards for inside bodywork. Hard compressed asbestos millboards for ceiling.
...	...	...	Not required.
...	...	...	Teak wood lining and French polished.
...	...	...	« Decolite » and « Induroleum ».
...	No.	Hoppers not used.	None.

QUESTION.	India.	
	Bombay, Baroda & Central India.	Eastern Bengal.
6. **Results obtained in traffic.**		
a) *How have the all-metal vehicles behaved in traffic working, (i. e. have they proved satisfactory or otherwise)?*	Satisfactorily.	Not comfortable as timber. Summer warmer. Winter colder.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	No.	No experience.
c) *What are the advantages or expense of upkeep as compared with vehicles built of timber?*	Duration of service too limited to express opinion.	Expense of upkeep highe[r] due to extreme humidity o[f] climate causing oxidisatio[n] of light body framework and panel plate to be ver[y] rapid.

Continued.)

East Indian.	Great Indian Peninsula.	North Western.	South Indian.
...	Satisfactorily.	Not sufficient time in service.	Satisfactorily.
...	Stood up well in minor accidents. Only needed pillars straightening and panels replacing. Wooden coaches would have had majority of pillars broken.	...	No experience.
...	Difficult to compare; 1914 steel cars just completed their first extensive replacements. Interior panels below seats corroded and floors renewed. Only repairs 1914-1928 ordinary lift and paint.	Not yet known.	No reliable comparison but expect less cost.

QUESTION.	Japan. Government Railways.
1	
Advantages of all-steel construction.	
a) *Do you consider it is desirable that further research should be made in the direction of metal (steel) vehicles?*	Yes.
b) *What are the reasons which justify you in this belief?*	To get stronger construction — save wood, now getting scarce. Longer life and lower repair cost of vehicles.
2	
Types of carriages in service, under construction or projected.	
a) *Have you built or considered the building of metal coaches?*	Since 1927.
b) *What is the general principle underlying their construction?*	*Old design.* — Heavier type of underframe with fish-belly centre sills.
c) *Stronger underframe with a lighter body.*	*New design.* — Lighter centre sills of channels. Vertical load carried by side framing. Solebar of simple angle bar being one member of side frame. Posts and piers of plate in special cross section, side sheathing of plate.
d) *Lattice-work solebars*	
e) *Bulkhead tubular section, etc.* . . .	
f) *Has this method of construction been applied or is it a practical proposition in regard to :*	
1. *Carriages with end doors only.* . .	End doors only (vestibule).
2. *Carriages with side doors*	Large side doors on electrified lines.
3. *Suburban and District sets.* . . .	...
4. *Carriages on light railways (tramways).*	...

QUESTION.	Japan. (*Continued*). Government Railways.
3 **Process and materials of construction.**	
a) *What are the principal materials you have used in the construction of such vehicles; profiled and shaped sheet iron plates, stamped sheet iron plates, steel plates moulded to pattern, malleable cast iron?*	Pressed steel cross bearers. Shaped steel other members. Pressed steel posts and piers.
b) *How do you constitute the floor of the vehicle?*	Wooden floor planks — linoleum covered for 1st and 2nd class.
c) *Have you utilised light metals (alloys) in order to reduce the weight of your carriages. In what circumstances and what alloys have you used?*	Not yet.
d) *What method of assembly have you adopted. Riveting, oxy-acetylene, welding or electric arc or spot welding?*	Chiefly riveting; welding at certain places.
e) *Do you maintain rivet heads on the outsides of the vehicles?*	Yes.
f) *To what extent have you maintained the use of timber for partitions, flooring and interior finishing work?*	Furring, roofing, head lining. Inside finish and flooring.
g) *What special steps have you taken to prevent oxidisation of the metal plates*	Copper bearing steel plates under test.
h) *What classes of paint do you use on the outsides and on the insides — lacquers, cellulose, etc.?*	*Outside.* — Some coated with Japan lacquer, others oil paints. Urushi (Japan lacquer) is a better rust protector than oil paints. *Inside.* — Head lining enamel oil or cellulose lacquer. Above windows oil varnish, other parts spirit varnish.

QUESTION.	Japan. (*Continued*). Government Railways.
4	
Interior fittings.	
a) *How have you arranged for the interior fittings of carriages with metal bodies, and the disposition of compartments, corridors, vestibules and W. C's.?*	As in wooden cars vestibule panels all of steel plates. W. C. above window sill of wood; below lined with tiles (1st and 2nd) or artificial stone (3rd). All centre aisle — American type saloon, except 1st sleepers of European type with side corridor.
b) *What new problems have you had to solve as a result of metal construction of carriages, particularly in regard to :*	
1. *Ventilation*	Monitor suction (« Garland ») found satisfactory.
2. *Heat retention*	Felt lining on insides of panels — fairly satisfactory.
3. *Heating*	Vapour adopted in lieu of pressure system.
4. *Decoration*	Ply wood interior finish. No need of special decoration.
5. *Noise prevention*	None noticed.
c) *Have you taken any special steps in regard to the emptying of the hoppers of W. C's.?*	None — closet hopper being cleaned with flush of water.
6.	
Results obtained in traffic.	
a) *How have the all-metal vehicles behaved in traffic working (i. e. have they proved satisfactory or otherwise)?*	Satisfactory.
b) *Have you obtained any information as to their behaviour when they have met with accidents or collisions?*	Not yet.
c) *What are the advantages or expense of upkeep as compared with vehicles built of timber?*	No data — only 2 years service; expect more saving compared with wood. No need for all-steel — prefer wood interior.

[625 .258 & 656 .212.5]

REPORT No. 2

(America, British Empire, China and Japan)

ON THE QUESTION OF METHODS TO BE USED IN MARSHALLING YARDS TO CONTROL THE SPEED OF VEHICLES BEING SHUNTED, AND TO ENSURE THEY TRAVEL ON TO THE LINES IN THE VARIOUS GROUPS OF SIDINGS (SUBJECT X FOR DISCUSSION AT THE ELEVENTH SESSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION),

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Figs. 1 to 21, pp. 718 to 750.

INTRODUCTION.

The title of question X has given rise to a certain amount of speculation as to how large a field it is desired to embrace, *i. e.* as to whether or not it is the intention to confine the subject largely to the comparatively recent innovation and development of operating gravity shunting yards mechanically, that is by what appear to be generally known as « Car retarders » or « Rail brakes ».

It will be advisable, therefore, to recall that at the London Session in 1925 the question of « Shunting yards » was considered, and particularly having regard to the close relationship between some of the subject matter then dealt with and that which will be included in this report; below are quoted the more relevant extracts from the summary of reports on shunting yards as finally adopted :

11. The height of the hump or the gradient of the continuous slope should be such that all the trucks, whatever their running conditions, attain sufficient speed to reach their correct destination on the shunting lines. This result ought to be obtained even under unfavourable atmospheric conditions.

The speed should, moreover, be such that when the points are reached the trucks have sufficient interval between them.

12. The speed of wagons should be capable of being reduced when required. In order to carry this out there are various methods in use amongst which may be noted shoe brakes, either mechanical or otherwise, or braking rails, automatic or non-automatic, which are dependent upon the weight of the wagon, etc.

Article No. 12 does not specifically mention brakes fixed on wagons, but as all British railway rolling stock for the conveyance of goods and mineral traffic is fitted with hand brakes, as well as much of the stock in other countries, and as there are no marshalling yards in Great Britain equipped with rail brakes or shoe

brakes operated mechanically, with the exception of one yard which up to the time of writing has not been formally opened, it is proposed to deal with the subject on broad lines and to review it as widely as practicable, dealing with the question of braking wagons both where no independent mechanical apparatus exists and where such has been introduced.

Similarly, with regard to that portion of the heading which reads : « to ensure they (the wagons) travel on to the lines in the various groups of sidings » there is some uncertainty in the interpretation of it, but it is regarded as applying to point or switch operation, signals between enginemen, shunters, point or switch operators, etc.

Wagon brakes and hand braking methods, Great Britain, etc.

It is not considered that any useful purpose will be served by traversing past history in regard to the development and modernization of hand brakes fitted to wagons, from the early days when shunting at some of the marshalling sidings was performed by horses, when speed of operation was not the essential nor the practicable accomplishment it is to-day, when hand brakes were either non-existent or (in present day understanding) very inefficient, and when « spragging » the wheels by inserting pieces of timber between the spokes was no doubt relatively more prevalent than now (sprags are still used in Great Britain, but broadly speaking only in cases of emergency or to secure wagons standing on inclines).

In view, however, of the fact that the hand brake fitted to the wagon and operated from ground level is in Great Britain the principal method of controlling the speed of vehicles being shunted, *i. e.* when not attached to an engine, either on flat ground track, or on continuous gradients, or down hump gravitation banks, a survey of the general situation is necessary, more particularly for certain reasons to be mentioned later.

Regulations laid down by the British Government Department concerned, in the matter of braking requirements on wagons, are contained in a document known as the « Prevention of Accidents Rules 1911 » and issued by the then Board of Trade (now Ministry of Transport) on 7 November 1911, being Board of Trade Rule 1058.

This rule specified that with certain exceptions all new wagons for use on any railway should be fitted by the owners with brake levers on both sides and should comply with certain conditions, also that all wagons then existing or being constructed should also be similarly fitted with brake levers on both sides, within a given period of years, based on the number owned, *i. e.* those railways owning the largest stock were allowed the longest time wherein to carry out the work. As a matter of fact in the case of at least one of the bigger stock owning companies this period has not yet (1929) expired, and although a great deal of such conversion and replacement has been accomplished there still remains much to be done, an extension of the time allowed having been found necessary and authorized.

The conditions to be complied with are set out in schedule No. 1, contents of which are quoted below :

Schedule No. 1.

1. The levers to be of like pattern, and to be so placed that each shall be to the

right of a man facing the side of the wagon.

2. Each lever to be so fitted that the brake can be conveniently applied with one hand.

3. The levers to be so fitted that the brakes can be released only from the side on which they have been applied.

4. The levers to be « press down and lift up », and to be provided in the « off » position with a stop.

5. Articles 3 and 4 of this schedule shall not apply to brakes of which the design has been approved by the Board of Trade.

Certain exceptions to the rules are contained in a further schedule, as follows :

Schedule No. 2.—Exemptions from rule.

a) Wagons used upon railways of a gauge less than 4 feet 8 1/2 inches;

b) Chaldron wagons of a carrying capacity of 5 tons or less;

c) Wagons of a carrying capacity of over 20 tons;

d) Boiler wagons;

e) All wagons fitted with the Dean and Churchward brake, as described in Specification number 202 of 1902, if arranged as a cross-cornered brake;

f) Any wagons with regard to which compliance with this rule is in the opinion of the Board of Trade, unnecessary or impracticable.

Provided that all wagons exempted under *c*, *d* and *f* are fitted on both sides with such other appliances as will enable sufficient brake power to be conveniently applied from either side, if, in the opinion of the Board, such other appliances are necessary.

The « chaldron » type of wagon referred to in schedule No. 2 (exemptions) is described by an authority as the original ancestor of the British standard freight and mineral wagon. It is still used in certain localities for coal and ore traffic but as a type, or at any rate as a term, it may be regarded as almost having ceased to exist, and is practically out of use on passenger carrying lines.

All new goods and mineral wagons of recent and current construction and the majority of privately-owned rail vehicles of modern design in Great Britain are fitted with a standard type of brake complying with the above mentioned regulations. varying only in certain technical and minor details and according to the size and capacity of the wagon.

A drawing of the standard brake is given in figure 1. It is of the two-wheel action variety and is duplicated, *i. e.* there is a long lever on each side of the wagon each of which operates metal brake blocks on the two wheels on the same side as the lever. A photograph of a London Midland & Scottish Railway standard 12-ton wagon fitted with this brake is given in figure 2, the brake being in the « off » position.

The brake lever and gear are not normally painted white. No good purpose would be served by so doing, as for obvious reasons they would quickly become dirty. They were specially painted in this and subsequent illustrations for the purpose of clarity in the photographs.

It will be noticed that there is a rest at the top of a bracket to hold the lever when the brake is out of use, and when in use brake pressure on the wheels is applied by downward manual movement from the handle end — a cotter pin being provided to hold the brake in a fixed « on » position when necessary. In some instances the bracket is of the tooth rack variety. Figure 3 shews the brake in the « on » position.

In addition to the standard 2-wheel action brake which, as fitted to a London Midland & Scottish Railway standard

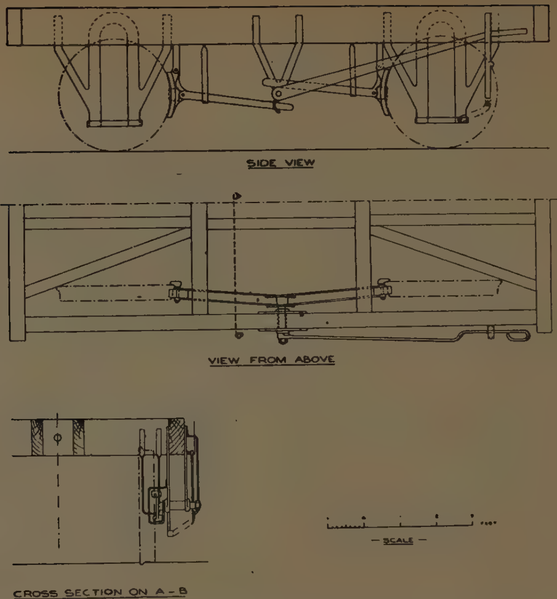


Fig. 1. — Arrangement of hand brake on London Midland & Scottish Railway standard 12-ton wagon.

Fig. 2. — London Midland & Scottish Railway standard 12-ton wagon shewing brake lever and gear with brake in « off » position.

Fig. 3. — View of standard brake lever and gear with brake in « on » position.

12-ton wagon, has a brake leverage or « mechanical advantage » of 22 to 1, there is a 4-wheel action brake with a braking ratio of 30 to 1. This type of brake is fitted to certain wagons of higher than the average capacity, on which one lever movement must apply a brake block on all four wheels, *e. g.* 20-tonners, and some tank wagons, although it is permissible to use it for ordinary say 10 or 12-ton wagons at the option of the owners. This brake also has a lever on both sides of the wagon.

Some wagons are fitted with a ratchet brake of the type referred to in the list of exemptions *e*) quoted above with a short lever working in a cross-cornered position. Another railway owns wagons with a brake operated by a short lever manipulated horizontally.

On certain of the highest capacity 4-wheeled or 8-wheeled vehicles, the brake is manipulated by means of a hand wheel at the side of the wagon.

In some types of long brake lever the handle end, which is plain, extends beyond the headstock, whilst some have a handle which only extends short of the headstock and may be straight, curved, or elliptical.

In some instances, wagons fitted with the ratchet brake have a cross-cornered lever on each side of the wagon but at the same end, and thus, although when facing the wagon from one side the lever is to the right hand, when facing the wagon from the other side the lever is to the left hand. This lack of uniformity is occasionally found in the case of ordinary lever manipulated brakes.

Apart, therefore, from the wagons which still remain fitted with brake levers on one side only, and which as previously stated require to be fitted with brake levers on both sides by a given date (*i. e.* all wagons whether railway or privately owned which have to run over main lines), there is an appreciable difference in types, due to some extent possibly to unavoidable circumstances, but permissible for the time being provided they do not definitely contravene the regulations.

A few illustrations are given in figures 4 to 8 of hand brakes which vary from the principal standard pattern and/or arrangement.

It will be appreciated that the more evenly wagons or cuts are spaced as they move down a gravitation bank through the point or switching area, the more satisfactorily and expeditiously will the process of humping be carried out. At many yards, however, the traffic is of a mixed character, and consists of loads and empties, and wagons of different types and capacities.

Moreover there is, in Great Britain, a period of transition taking place in regard to lubrication, and grease axle boxes are being gradually replaced by oil axle boxes. Complete figures in respect of the whole of the country are not available, but taking the stock belonging to the London Midland & Scottish Railway there were on 31 December 1928, 101 750 vehicles fitted with grease axle boxes and 216 060 with oil axle boxes — the latter number increasing at the expense of the former, at the rate of about 15 000 a year. The enhanced running power of the oil lubricated wagon, as compared with grease or fat, both of which class of wagon have to be dealt with concurrently, adds to the difficulty of spacing wagons evenly.

As wagons belonging to all railways and many different private owners are dealt with in common at the hump yards it will be obvious that the more numerous the departures from one standard type of

Figs. 4 to 8. — Exceptions from principal standard type of hand brake.

Fig. 4. — Extended hand lever.

Fig. 5. — Left hand side lever.

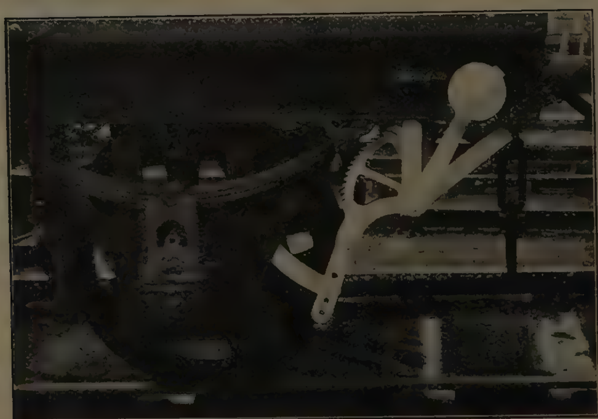


Fig. 6. — Cross cornered ratchet brake.

Figs. 4 to 8. — Exceptions from principal standard type of hand brake (*continued*).

Fig. 7. — Horizontal type lever.

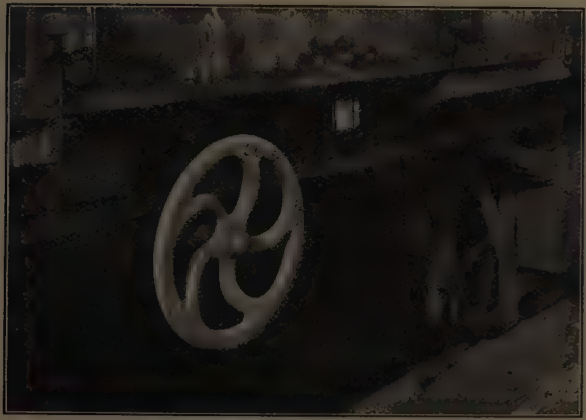


Fig. 8. — Hand wheel brake (high capacity wagons).

hand brake and position of lever, the less efficiently and expeditiously is the work of humping carried out.

This question has not only a national but an international aspect, owing to the introduction of train-ferries such as be-

tween England and the Continent of Europe, and also the possibility of a railway tunnel being constructed under the Straits of Dover between England and France. Continental wagons (covered vans) already work over British lines via train-ferry service, but only as yet in very small numbers comparatively.

The method followed in England and most of the countries under review, except perhaps the United States and Canada, of applying hand brake pressure to wagons moving down gravitation banks, is for shunters or men classed as brakesmen, wagon-steadiers (sometimes referred to as wagon-chasers) to walk or run alongside the wagon as far as necessary or conveniently possible, manipulating the lever handle as required to exercise the desired brake pressure.

To supplement the leverage, a « brake stick » is used, where authorized in conjunction with certain types of brake lever. The stick is placed over the brake lever with one end under an appropriate part of the underside of the wagon, and the handle end of the stick is pressed down, thereby enabling a greater degree of leverage. The brake sticks as used on the London Midland & Scottish Railway are of hickory and are 3 feet 3 inches long. The bottom half approximately is rectangular, being 2 1/2 inches by 1 3/4 inches at the extreme end and narrowing to 2 1/4 inches by 1 3/4 inches at the shoulder, whence the top half tapers into an ordinary round handle of suitable thickness to be gripped comfortably.

In addition to the efficient and economical performance of hump or gravity shunting operations, so as to reduce the cost of working to a minimum, the importance of adequate and uniform braking apparatus in relation to avoidance of damage to rolling stock and contents and spillage of traffic, must not be overlooked.

As common carriers the Railway Companies, in Great Britain at all events, convey merchandise under various conditions, terms or contracts of carriage, *e. g.* Company's risk or Owner's risk — which features are outside the ambit of this report but they (the Railway Companies) pay considerable sums by way of compensation to forwarders or receivers of freight, who make claims for goods damaged or spilled in transit. It is not suggested that such damages or losses occur solely in shunting yards, hump or otherwise, nor are any reliable statistics available to demonstrate the proportion of damage occurring in the process of shunting down gravitation banks as compared with that arising from other circumstances, but there is a feeling that an appreciable portion of such damage does in fact take place at hump or gravity shunting yards either through carelessness on the part of employees or their inability with the means at their disposal to control effectively the speed of vehicles being shunted. On the other hand damage to goods takes place owing to inefficient or insufficent packing, and spillage occurs when open wagons of say coal are overloaded.

The matter is, however, one receiving close and constant attention, and various methods are adopted with a view to the avoidance of damage to goods and rolling stock through coming into too sharp contact with one another. In addition to the traffic label placed on all loaded wagons in Great Britain at the time of forwarding, and indicating sending point, destination, route, consignee, etc. it is the practice to indicate all easily damageable or displaceable loads by means of some supplementary indication such as « Shunt with care » either incorporated in the or-

dinary label or comprising a separate and distinct label. This separate label varies in size, shape, and position of affixing, according to the practice followed by the different railway administrations. One adopts an oblong shape with red letters « Shunt with care » on a white background and which is usually fixed on the side of the wagon. Another uses a triangular label suitably inscribed but placed on the end of the wagon. Inasmuch as wagons of all administrations are dealt with in common, it is obvious that standard practice as between the different railways is desirable, so that shunters and brakesmen may know exactly where to expect to find these special indications.

Again, the more efficient control of the speed of wagons containing loads of the character under notice, which is essential, cannot promptly and adequately be exercised, unless under hand braking practice, there are wagon levers on both sides. Moreover, the work of the brakesman is facilitated and the risk of damage reduced, if the brakes are of standard type and the levers in a standard position. At present, however, this ideal has not yet been completely attained.

It must not be assumed from what is stated above that there is a widespread lack of uniformity on British railways. Actually the reverse is the case, as generally speaking a high standard has been attained, but exceptions such as those quoted are not conducive to efficient working at the larger humping yards, and the matter is, therefore, mentioned for general information.

It is desirable that suitable orders should be issued for the guidance of the staff concerned at the larger humping yards. The standing instructions to yard staff on the London Midland & Scottish Railway engaged in hump or gravitation shunting are set out below for information :

Gravitation shunting. — Shunters, goods guards, and all concerned must exercise great care in shunting at gravitation sidings, to prevent injury, damage or loss.

In shunting special loads, wagons labelled with « Brittle goods », « Fragile », or « Shunt with care » labels, also special vehicles, a man must, when necessary, accompany the vehicles throughout, controlling their movement into the sidings to avoid them coming into sharp contact with the stop blocks or vehicles already in the sidings. The same care must be observed to avoid subsequent shunts from colliding sharply with the special loads.

Live stock must not be shunted at gravitation sidings if it is possible to avoid it. In all cases where it is necessary to shunt live stock traffic at gravitation sidings, it must be attached to an engine, in accordance with Rule 113, clause *b*, otherwise a man must accompany the vehicle which must be worked at a walking pace from the summit until brought to a state of rest in the sidings.

Yard masters, station masters, and inspectors in charge must frequently satisfy themselves that these orders are being carried out.

The method of working, the number of staff required and the disposition of the men vary according to the lay-out of the sidings and the number of wagons dealt with during a given period. At a large yard dealing with say 3 000 or 4 000 wagons a day there may be an inspector or foreman in charge of gravitation operations with a suitable complement of men (usually graded as « shunters » in Great Britain) to perform the duties of chalking on the wagons the number of the siding for which intended or otherwise recording or deciding the particular siding for which destined, unhooking the coup-

lings, steadying (by hand braking) the wagons as they proceed down the incline so as to maintain the requisite space between them, and accompanying the wagons as far as may be necessary for the purpose of applying hand brakes.

Obviously at places where there is not a more or less continuous stream of trains arriving and wagons to be gravitated or shunted, the time of the men employed is not fully occupied unless some of the duties mentioned above are suitably amalgamated. This is in fact the practice at yards where smaller numbers of wagons are dealt with, one man for example combining the duties of unhooking and indicating the siding for which destined. There is of course an economic limit to the extent to which this amalgamation of duties can be carried, but the ideal is to avoid unproductive time, in addition to which unoccupied periods are not conducive to the proper morale of the staff concerned. Such an ideal state of affairs is not, however, always feasible in practice, as it is not possible to so arrange train services in every case to fit in with the most economical marshalling yard requirements and, therefore, in some instances waste time is unavoidable.

If, therefore, some simple means could be devised whereby at hump or gravitation yards dealing with what can perhaps best be described as a medium to small amount of traffic, say one man, suitably located, could combine the duties of braking wagons and operation of points, some saving in staff costs should be practicable.

The idea is not exhaustive, but the only possibility at the moment would appear to be in the exploitation of electric, electro-pneumatic or electro-hydraulic power for point or switch operation and also for controlling the speed by means independent of hand brakes on wagons or cuts of wagons moving down inclines. Such methods are already in existence, as will be described later in this report, but they are comparatively few and are confined almost exclusively to yards where the number of wagons gravitated is considerable, or where complete new large yards are being or have been lately constructed or where, as in the United States, the wagons or cars are of comparatively large capacity.

The cost of installing such requisite apparatus as is available to-day is very considerable, and the advantages to be gained and economies to be derived at medium and smaller yards do not appear to be commensurate with the out-lay. Cheaper electricity and simplified apparatus seem to be the most potent factors in the development of the idea under review.

Rail shoe brakes or skates

As previously stated the principal method of controlling the speed of vehicles being shunted in Great Britain and Colonies, etc., is by means of hand brakes with levers fixed on the wagon side. The only other means employed (excepting the London & North Eastern Railway installation at Whitemoor and the car retarders and power operated skates in America, which will be dealt with separately) is the manually operated rail shoe brake, skid, skate or slipper, but this is only used to an extremely small extent and comparatively at a very few selected places.

A typical shoe is illustrated in figure 9 and it may be used in conjunction with a « switch-out » in the rail, or without. The wearing parts of this particular shoe

or skid are made of hardened steel and are renewable.

The arrangements for their use are described in the following instructions issued for the guidance of the staff concerned by the Great Western Railway at their East Depot up side marshalling yard at Bristol :

Shunting skids. — Portable shunting skids are provided in the « hump » sidings to assist the shunters in controlling the movement of wagons. One of these must be used when a wagon is observed to be running from the « hump » at a speed which is likely to cause damage to it or other wagons standing in the siding or their contents. In order to avoid damage to the skids and possible derailment, a skid must not be placed on the rail in such a position that the approaching wagon could push it along a line where there is a crossing or the tongue of points.

The skid must be taken off the rail immediately after the wagon to which it has been applied has been brought to a stand.

The Great Western Railway report that the skids are effective on dry rails but on wet and slippery rails they are inclined to slide with the wheels before pulling the wagons up. They state also their experience is that with a cut of, say, 4 wagons, consisting of three heavy loads and an empty or lightly loaded wagon leading, the skid is not so effective. Although it is laid down that skids must not be placed on the rails where points will be easily fouled by skids riding the rail in front of the wagons, this is adhered to as far as possible, but it is found particularly at night when outgoing trains have to be dealt with that the sidings which are dead-ended and comparatively short, are soon filled and there is often no alternative but to take the risk of getting the skids flattened out at the points. With longer sidings there would be considerably less risk of damage to the skids as there would be space to use them on the siding straights instead of amongst the points.

The Great Western Railway state that even minor injuries reported are negligible, although the men have to exercise great care.

The use of purely manually operated skates in the countries embraced in this report is very limited. The only Administrations which make mention of them in reply to the general questionnaire are the following, and these utilize them only in very few instances comparatively :

London Midland & Scottish Railway, England;

London & North Eastern Railway, England;

Great Western Railway, England;

Bengal Nagpur Railway, India.

Madras & Southern Mahratta Railway, India;

Japanese Government Railways, Japan.

Some Administrations provide a switch-out or cut-out in the rail as indicated in the rough diagram, figure 10, for the purpose of ensuring the release of the skate at a definite spot.

When the wheel of a detached vehicle comes upon a track skate, which is placed on the down gradient of a hump, the skate moves on for some distance with that wheel and then escapes from the wheel owing to the construction of the line, while the vehicle runs on somewhat retarded.

Skates placed on rails by means of mechanically or electrically controlled apparatus as employed in the United States will be referred to later.

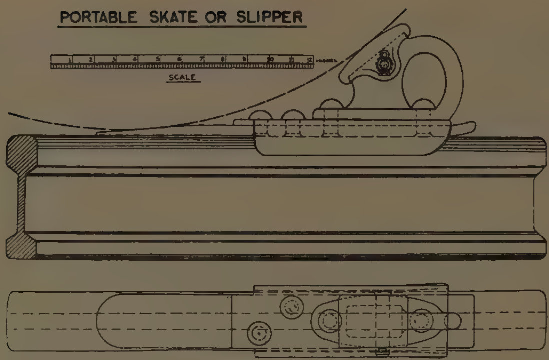


Fig. 9. — Manually operated skate or slipper.

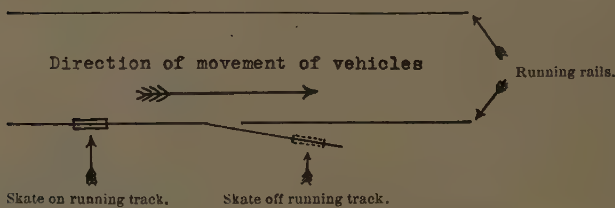


Fig. 10. — Method of switching out manually operated skates.

London & North Eastern Railway rail-brake installation, Whitemoor.

For some years past the railway companies in Great Britain have watched with considerable interest the introduction and development of rail-brakes and car-retarders in certain European countries and the United States. They have not, however, had the same problems to face as for example France where hand brakes were not in general use, and the United States where the employment of car-riders entailed heavy yard operating costs. Moreover, the average British freight rolling stock unit is smaller than that of many other countries and consequently can be more easily handled at hump yards.

Some time ago, however, the London & North Eastern Railway decided upon the construction of a new hump marshalling yard at Whitemoor near March and Peterboro' in order to enable them to deal better with the heavy coal and goods traffic from the Midlands and North to London and the Eastern counties. The question of incorporating up-to-date rail braking apparatus was carefully considered, and the conclusion reached was that the rail-braking methods invented by Dr. Frölich and in successful use at, amongst other places, Hamm in Germany, could advantageously be applied at their new Whitemoor yard.

A plan of the yard shewing the layout, gradients, position of the retarders, the

operating tower or control cabin from which the rail brakes and points are electrically controlled, is given in figure 11.

It will be observed that there are 10 arrival or reception lines and a double rail retarder is fixed on each of four leads off the hump, each serving 10 sidings, this being sufficient in the way of retarders estimated to be needed for British traffic requirements in a hump yard of this character.

Each retarder consists of four lengths of rail — one on the inside and one on the outside of each track rail — carried on transverse girders which are capable of being raised by hydraulic power. The brake rails, which are similar in shape to track rails, are about 50 feet long with an effective braking length of about 45 feet. When in the normal position, a wagon can pass through the rail brake without any braking action taking place, but when the brake rails are raised the action of the wheel flanges on the foot of the inner brake rails causes the side of the head of those brake rails to be applied to the inner sides of the wagon wheels, and at the same time draws the outside brake rails into contact with the outer sides of the wagon wheels.

The wheels are thus squeezed between the inner and outer brake rails, the amount of brake pressure applied depending upon the extent to which the brake rails are raised above the level of the undersides of the flanges of the wagon wheels, and also on the weight on the wheels, that is to say the weight of a wagon is a factor in regulating the maximum brake pressure which shall be applied. In this way it is claimed the speed of a wagon can be modified to any extent.

Three-position colour light signals at the top of the hump govern the speed of propulsion over the hump and klaxon horns are fixed alongside the reception sidings so that intimation of humping speed can be conveyed by code to the enginemen on the shunting engines in foggy weather.

Particulars of the wagons and cuts are taken on arrival of a train on the reception lines and a « cut-card » is made out, a copy being sent to the control tower. From the information on these cards the operators in the tower set up on an electrical apparatus the sequence of the leading points to be operated and wagons going over one pair of these points automatically set the points for the following movement.

The remaining points leading to each individual siding are electrically operated by hand switches on the switch table in the control tower as the wagons move down the hump and through the retarder, each switch being provided with a point-indicating lamp to shew the position of the points, and also a small lamp in the centre of it which lights up when a wagon passes through the points.

The arrangements generally are modelled largely upon, and the apparatus is somewhat identical with that at Hamm Yard, Germany, and which is understood to have been in successful use for some time.

Although the progress of the constructional work at Whitemoor has so far advanced as to enable tests to be made, the yard has not up to the time of writing been formally opened for traffic purposes. It is understood, however, from the experimental working which has taken place, and which is continuing, that the installation and the working of the new yard give promise of success.

In all the circumstances, therefore, it is not considered that at this stage further comments can usefully be made.

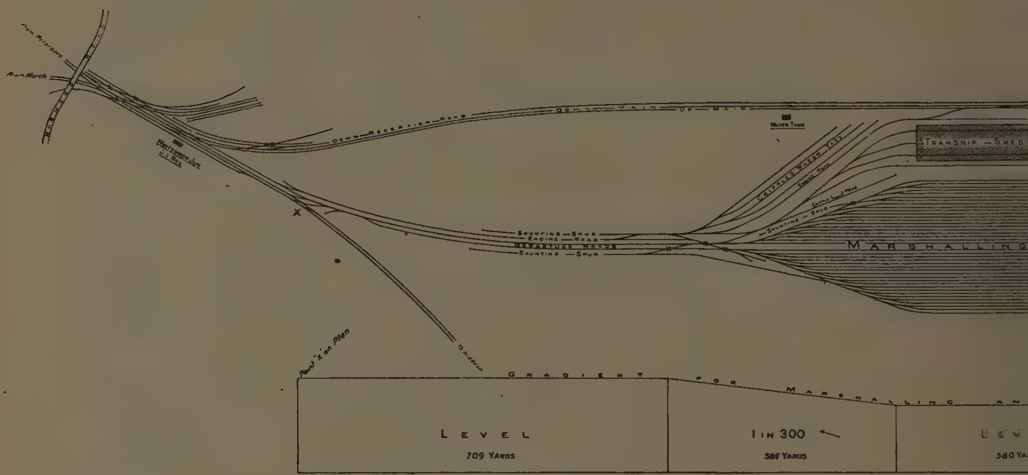


Fig. 11. — Plan of up side retarder yard,

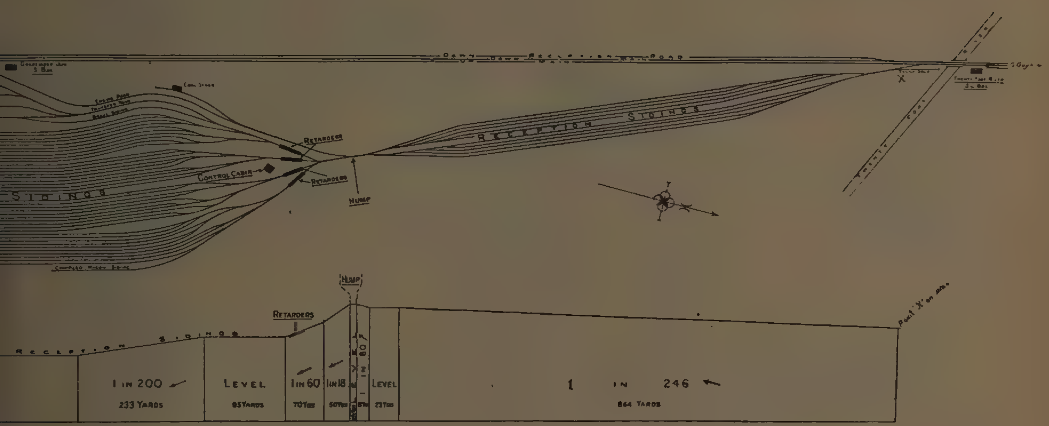
One feature of interest revealed is that a small percentage of British rolling stock is fitted with wheels which have certain projections beyond the face, such as bolt heads and nuts securing the tyre, which would foul the rail brake if applied when passing through and be sheared off. These wagon wheels will no doubt be suitably converted in time, and in the meantime special provision will be made at Whitemoor to deal with them independently of the rail brake apparatus.

Car retarding methods in the United States, etc.

The methods of wagon braking in the British Colonies and in many other countries follow very largely the general practice in Great Britain, with one or two notable exceptions, such as in the United States, etc., *i. e.* brake blocks apply pressure to the wheels on being manipulated by means of a lever or hand wheel operable from ground level.

In the United States, however, the practice and circumstances are different. Whereas in Great Britain the average wagon may be said to be one of 12 tons [1] capacity, with a tare or light weight of approximately 6 to 7 tons, in America

(1) These are British tons of 2240 lb It should be noted in this and subsequent references to tonnages that the United States ton is a « short » one of 2000 lb. For rough calculations, therefore, approximately 10 °/₀ added to any given number of British tons will convert them into equivalent U. S. A. « short » tons. Vice-versa 10 °/₀ deducted from à given number of U S. A. « short » tons will convert them into British tons.



itemoor, London and North Eastern Railway.

the wagons or cars are of very much higher capacity. This is an important point to note because it has a distinct bearing upon the development of mechanically operated gravity shunting yards in the U. S. A., and the manner of such development, also the comparatively large savings in operation which are said to have been effected.

There is not, in the U. S. A., anything which is quite the equivalent of the British 10 or 12-ton wagon (loaded gross weight say 15 to 20 tons in the case of coal, other minerals and heavy goods), which is generally considered to be the most economic freight vehicular unit having regard to the nature of traffic and the comparatively short hauls. It is true there is a gradual development of the use of higher capacity wagons, say 20, 30 or 40-tonners, but these are mainly for specific traffics and often for working between more or less fixed points in set trains, not involving their being dealt with over shunting humps. The proportion of such stock to the whole in Great Britain is very small. Specially constructed vehicles of high capacity for the conveyance of unusual loads are used, but these receive special individual attention at marshalling sidings.

The following particulars extracted from the 40th Annual Report on Statistics of Railways in the United States for 1926 give some idea of the much higher car capacity in that country, and incidentally furnish an interesting analysis of the classes of car in use :

Classification of freight cars, Class 1 steam railways on 31st December 1926.

KIND OF FREIGHT CAR.	Railway-owned.		Privately-owned.	
	Number.	Average capacity.	Number.	Average capacity.
		U. S. A. «short» tons		
Box	1 076 332	40.	549	Not available
Flat	102 009	41.6	1 491	
Stock	84 971	36 3	4 869	
Coal	948 833	52.3		
Gondola and Hopper	—	—	27 308	
Tank	10 432	43.5	144 664	
Refrigerator	44 828	32.5	109 319	
Others	81 238	50.3	403	
Total	2 348 643	45.1	288 603	

A further illustration of the marked difference between British and American conditions is revealed in the figures of average wagon or car loads :

	Average load in 1926.	
	Per car, U. S. A.	Per wagon, Gt. Britain
	U. S. A. « short » tons.	British tons.
Products of mines	50 74	
Products of forests	28.28	
Manufactures & miscellaneous	26.10	
Products of agriculture	23.53	
Animals and products	11.95	
TOTAL. Revenue traffic (carload)	35 11	
Less than carload traffic	Not available	
All traffic	27. 4	
Coal, coke and patent fuel		9 17
Other minerals		8.50
General merchandise		2.89
All traffic		5.06

It will be noted that the average capacity of the majority of vehicles in the United States is about 45 tons and that the average load is approximately 35 tons. As many of the cars have tare or empty weights ranging from say 20 to 25 tons, the loaded gross weight of coal and other mineral traffic may be said to be about 55 to 60 tons. There is a gradual extension of the use of higher capacity cars of

say 70 tons capacity with tare weights of anything up to 25 tons, so that there are many gross loads of nearly 100-ton individual units to be handled.

Sufficient has been said above to demonstrate the difference in the problems which have to be faced in the U. S. A. and Great Britain respectively. Briefly the unit of conveyance or conveyed can be differentiated as under, in round figures :

Car or wagon.	U. S. A. cars.	British wagons.	U. S. A. cars	British wagons
	U. S. A. «short» tons.	Equivalent U. S. A. «short» tons.	Equivalent British tons.	British tons.
Average capacity	45	13	40	12
Tare (light)	20	7	18	6 ½
Average load, all traffic	27	6	24	5
Average load, coal.	50	11	45	10

It is obvious, therefore, that hand braking methods such as exist on British railways would not be adequate for the much larger units in the United States. In actual practice all freight cars in the United States and Canada, in addition to being equipped with the Westinghouse air brake, are fitted with a hand brake for braking the car when it is detached from a train. This hand brake is operated from the top of the car by means of a hand wheel, placed at one end of the car. The wheel is reached by means of ladders fitted to the two sides at diagonal corners and at each end. The movement of the hand wheel is held by a ratchet, and increased purchase is obtained by means of a wooden sprag or short brake stick which is in common use by the car riders.

A photograph of the end of a United States car shewing brake arrangement, etc. is given in figure 12.

At all yards, therefore, where loose or gravity shunting is performed and where rail or shoe braking apparatus is not installed it is necessary for a man, generally known as a « car-rider » to climb on to a car to manipulate the brake wheel. Consequently a very appreciable number of men is required to carry out this operation if the speed of humping is to be maintained at anything like a satisfactory rate of working, as the cars are much longer than the average British wagon, the trains are longer, the run into the sorting sidings is longer on the average than under British conditions, in addition to which, the car-rider or brakesman has to remain with the car or cut or raft of cars until it is at rest (unlike Gt. Britain where the brakesman only accompanies a wagon as far as he considers necessary for adequate braking) and then he has to return to the summit of the hump to take his turn and accompany another car or cut of cars.

This system has long been recognized

Fig. 12. — Typical brake arrangement on United States car.

as unsatisfactory and is comparatively costly, by virtue of the large number of men required, particularly at yards of any size and where humping is more or less continuous, notwithstanding that facilities are provided at many places for bringing the car-riders back to the hump by mechanical means such as petrol trollies or electric speeder cars running on a specially provided track.

For instance, at the Enola yard of the Pennsylvania Railroad where there are separate eastbound and westbound humps the minimum number of car-riders per hump per shift recently was 25 and the number of cars dealt with per day over one hump was 3 000 to 3 500. At the Chaddesden sidings single hump of the London Midland & Scottish Railway over 4 000 wagons are regularly dealt with and the number of brakesmen employed per shift is normally 12.

The following particulars relating to Clearing hump yard, Belt Railway, Chi-

cago, illustrate further the costly methods inseparable from this form of operation. Taking a typical day each rider braked an average of 6.27 cars per hour and made an average of 5 1/2 rides per hour or a ride every 10 m. 54 s. Two riders were used for each cut of three loads and more riders for the longer cuts on the same ratio. The cuts, however, for the whole year 1926 averaged 1.75 cars per cut.

There is, of course, a very large difference in the gross tonnage handled per day or per shift by virtue of the much larger American car as compared with the British wagon, but from what has been stated above it will be appreciated that there is comparatively a much greater field for economy by devising some means of eliminating car riders in the U. S. A. than is possible by introducing methods which avoid the necessity for brakesmen working from the ground as in Great Britain.

The problem as to how to curtail the heavy cost in respect of car riders appears to have been overcome by the use of « car-retarders », experiments in connection with which are stated to have first been conducted in 1923 and developed under the direction of Mr. Hannauer when Vice-President of the Indiana Harbour Belt Railroad. A pneumatic rail braking system was installed at the north hump of the Gibson (Ind.) freight classification yard, Indiana Harbour Belt Line, a subsidiary of the New York Central, consisting of units built into the track at various points as required from the hump down through the yard and which were controlled from several towers without the use of individual car riders.

The basic idea of this car retarder was a set of brakes in the form of iron bars or rails parallel to the running rail or track, capable of being so operated as to apply pressure to the sides of passing car wheels to retard the motion of the car. In the original installation at Gibson Yard these brakes were operated by a set of levers, air cylinders and pistons, etc., constructed largely from standard air brake equipment for freight cars and controlled by air using ordinary enginemen's brake valves located in towers adjacent to the track. Later the control was changed to electric circuits so arranged with valves at the retarders as to give a selection of pressures for different degrees of retardation.

The system was also developed to include the operation of switches (points) and skate placing machines, which will be alluded to later — the entire equipment being covered by patents held by George Hannauer, Vice-President, and E. M. Wilcox, master car builder, of the Indiana Harbour Belt.

The installation of car retarders was completed on 1 December 1924, and the electrically controlled pneumatically operated switch machines were brought into use early in January 1925.

Whilst the idea of employing some such device was not new it is believed that the Gibson installation was the first practical and successful application of it in the U. S. A. and within 12 months its success was amply demonstrated by the results which may be summarized as follows :

1. All car-riders dispensed with (66 men daily).
2. Cars spaced more uniformly and closely in yard.
3. Rough handling minimized and damage claims reduced.
4. Necessity for preliminary train brake tests obviated.

*

5. Safety promoted by elimination of car riders particularly in Winter when cars, ladders, hand holds and brake wheels covered with snow and ice.

This preliminary success of the retarding apparatus is further evidenced by the comparative results shewn in the accompanying summary (*vide* table I) of operating performance, cost, etc., before car riders and switch tenders were dispensed with, *i. e.* for February 1924, and after *i. e.* February and June 1925, from which it will be seen that the average cost per car humped fell from

83.5 cents in February 1924, to
50.6 cents in February 1925, and to
33.0 cents in June 1925.

The success was all the more phenomenal because during the first month the complete installation was in use, *i. e.* February 1925, typical wintry conditions were experienced. It was also a peak period of the year from a working point of view but nevertheless traffic was dealt with at Gibson which in previous years had had to be handled at other yards.

Following upon the successful inauguration of the retarder methods at Gibson North Yard the system invented on the Indiana Harbour Belt Railway appears to have been taken over by two of the larger signal manufacturing companies, who rapidly developed brake operating and switch (point) control machines. One company developed the electro-pneumatic apparatus as used at Gibson Yard and the other a different system controlled and operated electrically.

It was not until 1926, however, that the second retarder installation in the United States was brought into use and this was at the East St.Louis hump classification yard of the Illinois Central Railroad. It is of interest to note this was of the all-electric type, and the apparatus was manufactured and installed by the General Railway Signal Company, Rochester, N. Y. The East St. Louis hump was reconstructed specially for the power-operated system and it was placed in service on 8 February 1926.

A full description of the latest available apparatus will be given later but a brief account of this retarder, the second to be installed in the U. S. A. and the first *all-electric* apparatus, will perhaps not be out of place. It consisted of a number of shoes, suitably mounted, parallel to the running rail, the shoe-beams being 3 ft. 8 in. long and joined end to end, individual adjustment being provided for each retarder shoe and the tension of each retarder spring with also an overall adjustment to take up shoe-wear. It is important to note that this reference to shoes has no connection with shoes, skids, skates or slippers, as they are variously designated whether operated manually or mechanically, and which are described elsewhere.

Adjacent retarders were capable of being abutted, where necessary, and so connected as to provide a continuous retardation surface, while allowing each one to be operated independently by its respective mechanism. Separately controlled retarder units were constructed in sections of 3 ft. 8 in. and furnished in lengths varying from 14 ft. 8 in. to 40 ft. 4 in. for double rail application or the equivalent in rail feet for single rail application.

The third retarding apparatus to be brought into use in the U. S. A., appears to have been at another yard of the Illinois Central Railroad, *i. e.* the North-bound yard known as Markham, at Hazelcrest (Ill.) near Chicago, which was opened officially on 8 March 1926. In

TABLE I. — **Comparative summary of working and costs, Gibson Yard, Indiana Harbour Belt.**

	Quantities.			Costs (in dollars).		
	February 1924 (29 days).	February 1925 (28 days).	June 1925.	February 1924.	February 1925.	June 1925.
1. Cars humped	42 534	45 283	41 863	...	...	...
2. Average per day	1 467	1 617	1 395	...	...	...
3. Mean temperature	30°	30°	75°	...	...	...
4. Engine hours	1 840	1 338	620	19 320	14 149	6 510
5. Conductor hours	696	648	533	578	538	467
6. Switchmen hours (includes car riders in 1924).	14 192	2 787	1 333	10 928	2 146	1 035
7. Switch tender hours	3 480	...	...	2 053	...	...
8. Hand-brake testers.	58	...	...	400	...	...
9. Retarder operator hours.	...	3 360	2 664	...	3 125	2 500
10. Messenger service hours.	...	270	300	...	122	131
11. Maintenance.	...	...	...	...	1 758	2 282
12. Power.	...	...	...	...	1 125	902
13. Personal injuries	...	...	...	2 263	55	None.
Grand total.	...	...	...	35 541	22 918	13 813

Savings not included is the above.

14. Saving in cleaning yard.
15. Reduced car damage.
16. Reduced freight damage.
17. Increased humping capacity.

this case the *electro-pneumatic* car retarder system of the Union Switch & Signal Company was installed. The firm adopted their standard electro-pneumatic switch (point) machine for the operation of the car retarder. The brake shoes on the car retarder beams are forced against the inside and outside faces of the car wheels by compressed air acting on a piston, which through levers transmits the force to the brake shoes. The application and release of this air and thereby the operation of the retarder are controlled electrically by means of three control valves each including a magnet with an air valve.

A pressure controller is provided, and so constructed that various pressures may be applied to the operating cylinder thus varying the pressure exerted by the retarder, so that by using these different pressures, cars running at different speeds are controlled as desired.

In addition to the Northbound yard at Markham, the Illinois Central have a Southbound hump yard where the all-electric type of retarder has been provided. Both yards were newly constructed when the apparatus was installed.

This briefly is the history of the early developments of « car-retarders » in the United States. It was a natural corollary to the success attained at the Gibson Northbound yard that the Indiana Harbour Belt authorities should extend the system originally inaugurated by Mr. Hannauer, and by 1926 the Southbound yard at Gibson and the Blue Island yard were fitted with electro-pneumatic and all-electric apparatus respectively.

Other railroads did not fail to appreciate the advantages and economies to be derived with the result that further yards were equipped in 1927 and 1928 as will be seen from the accompanying summary (table II).

Further yards are understood to be undergoing the process of construction or conversion to retarder-working, so that there are practically 20 yards in the United States so equipped.

It should be noted that the only two types, *i. e.*:

1. Electro-pneumatic, and
2. All electric

as manufactured by the Union Switch & Signal Company and the General Railway Signal Company respectively are almost evenly divided.

Fresh features and improvements continue to be embodied in newly installed apparatus, layouts, location and number of retarders, etc., although the basic idea of the retarder still remains.

It is proposed, therefore, to describe in greater detail a typical car retarder yard of more recent design and to supplement this with any observations necessary.

The general arrangement is to have a reveiving yard, or a series of reception lines, situated in advance of the shunting hump where considerations of space permit, so as to simplify operations and minimize handling. These reception lines are, where practicable, of sufficient length to accommodate a whole train — anything up to a mile in length, and may consist of 75 to 100 cars. Unlike the practice at hump shunting yards in England where the process of humping can often be proceeded with almost immediately after arrival of a train on the reception lines (provided other considerations are favourable), certain special features necessitate some standing time before humping commences which is essential in the United States for the purpose of :

1. Bleeding the train of air, all cars being fitted with air braking apparatus.

2. Inspecting cars of perishables to ascertain condition of refrigeration and ventilation.
3. Feeding axle-boxes with hot oil when necessary.
4. Making out switching lists where not done from preliminary telegraphic advices

in addition to uncoupling the automatic couplers, etc.

A hump of suitable dimensions is provided and the propelling of trains over it is performed by engines of adequate power, except where the reception lines are on a falling gradient towards the hump, when a hump in the nature of a comparatively small knob is constructed sufficient to take the slack off the couplers for uncoupling.

The speed of propulsion over the hump by the propelling engine is governed either by colour light signals, or position light signals.

At the Norfolk and Western Railroad's Portsmouth electro-pneumatic retarder yard, position light signals govern the hump and trimmer movements in accordance with following arrangement :

Hump fast — Lights vertical.
Hump slow — Lights at 45° in right hand quadrant.
Stop — Lights horizontal.
Back up — Lights 45° left hand quadrant.

The trimmer signal facing towards the classification yard is mounted on the same mast as the hump signal and gives two indications, « trim » when lights are vertical and « stop » when horizontal.

The control levers for both these signals are located at the top of the hump and are handled by the yard conductor.

At another modern hump yard a colour light signal giving the following indications is repeated the entire length of the receiving yard by three repeaters which shew the signal indication in both directions :

Hump fast — Green.
Hump slow — Yellow.
Hump medium speed — Double yellow.
Stop — Red.
Back up — Yellow and red.

Klaxon horns for use during fogs are situated between each repeater signal, two means of signalling thus ensuring quick response by the enginemen.

As cars run down from the summit of the hump into the various sidings, their rate of speed and the distance they require to travel have to be gauged by one or more retarder operators located in one or more towers who by moving a lever or depressing a key cause the brake beams of the retarder to press upon the car wheels. It will be seen from table II that there is an appreciable number of such retarders at some of the yards concerned.

It does not necessarily follow that the number of retarders shewn therein is the number of « locations » of retarders, because as previously described, retarder units can be grouped. It is nevertheless a fact that in the early days of development of retarders in the United States the locations were numerous, as will be seen from the diagram (fig. 13) of one of the earlier yards. There were grouped retarders on both rails on the lead down from the shunting hump and a series of grouped or individual retarders at various points until well within the entrance to each individual siding. In some instances single rail retarders were provided, *i. e.* applying on one rail only.

Apart from the fact that the comparatively high capacity American car and load necessitates a series of retarders

TABLE II. — **Car retarder installation**

Year.	RAILROAD.	Location.	Number of classification tracks.	Number of towers.
1923-1924	Indiana Harbour Belt.	Gibson, Northbound.	...	5
1926	Illinois Central.	East St. Louis, Ill.	26	4
	—	Markham, Southbound.	44	4
	—	Markham, Northbound.	67	5
1926	Indiana Harbour Belt.	Blue Island, Ill.	30	5
	—	Gibson, Ill., Southbound.	30	2
1926	New York, New Haven & Hartford.	Hartford, Conn.	24	2
1927	Boston and Maine.	Boston, Mass.	29	2
	—	Boston, Mass.	30	2
	—	Mechanicville, N. Y.	36	2
1927	Central New Jersey.	Allentown, Pa.	24	3
1927	New York Central.	Selkirk, N. Y.	25	3
1927	Norfolk and Western.	Portsmouth, O.	36	2
1928	Texas and Pacific.	Lancaster, Ft. Worth.	32	2
1928	New York Central.	De Witt Westward, Syracuse, N. Y.	27	3
1928	Lehigh Valley.	Coxton, Pa.	17	1

completed in U. S. A.

Number of retarders.	Rail-feet-retarders.		Number of power switches.	Number of switch signals.	Number of power skates.	Type.
51	...		...	...	...	Electro-pneumatic.
	Double.	Single.				
52	1 683	33	28	28	26	All-electric.
80	2 445	132	46	46	44	All-electric.
121	3 408	256	69	69	65	Electro-pneumatic.
65	2 185	201	34	...	...	All-electric.
29	840	200	32	32	...	Electro-pneumatic.
[illegible]	1 089	0	24	...	24	All-electric.
16	1 232		28	...	...	Electro-pneumatic.
15	1 100		30	...	...	Electro-pneumatic.
17	1 287		35	35	...	All-electric.
20	1 305		23	...	24	Electro-pneumatic.
[illegible]	[illegible]		25	25	12	All-electric.
34	2 053		44	44	37	Electro-pneumatic.
21	1 611		38	38	32	All-electric.
17	1 309		28	28	27	All-electric.
11	814		17	17	17	All-electric.

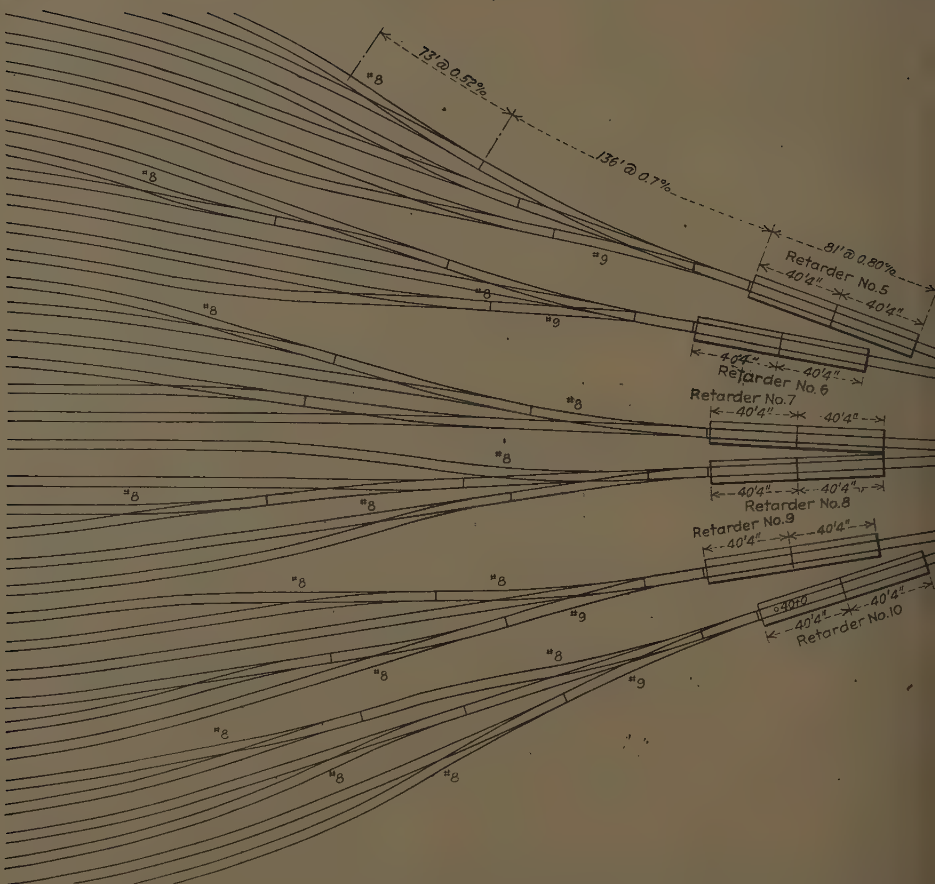


Fig. 14. — Diagram shewing lay-out of one of the more recen

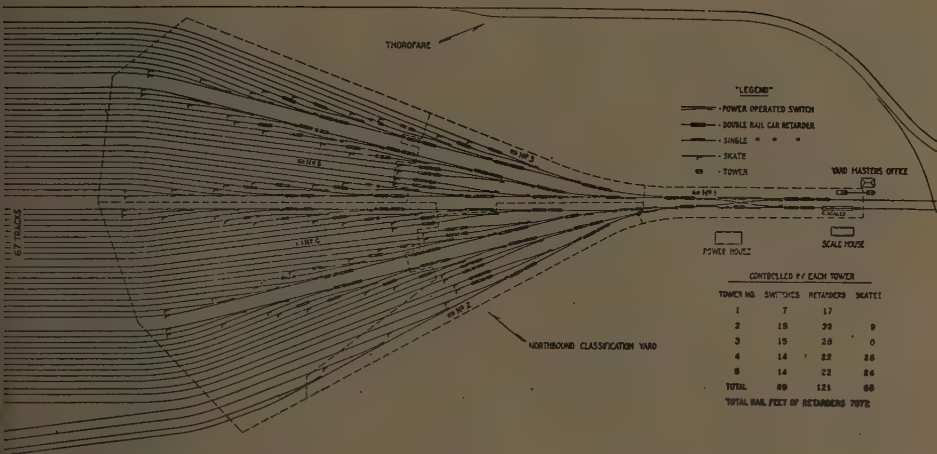
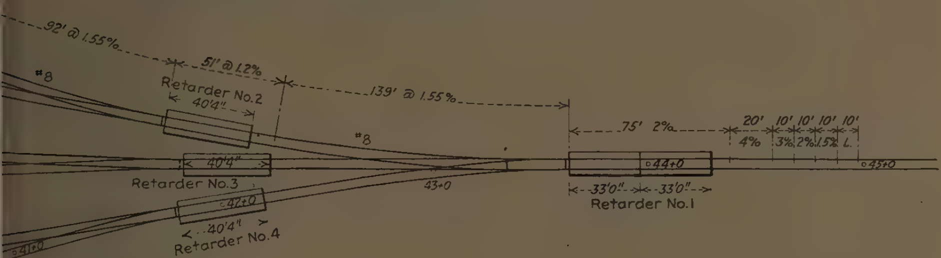
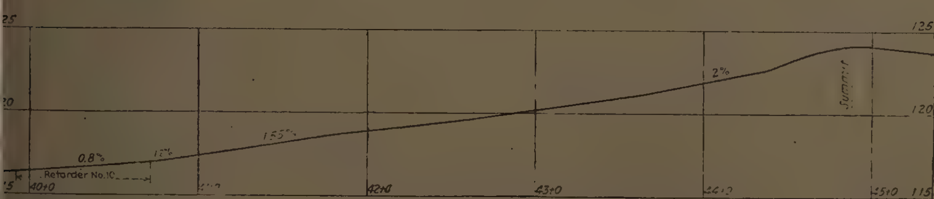


Fig. 13. — Diagram shewing lay-out of one of the earlier United States car retarder yards, and location of retarders.





Profile from summit to retarder No. 10.

United States car retarder yards, and location of retarders.

there would seem to be no doubt that their multiplicity in the earlier designs was due to two main factors :

1. The layout at the entrance to the sidings not being so scientifically designed and
2. Perhaps a desire on the part of the original inventors and developers of the idea to err (probably wisely) on the side of safety in the matter of braking.

Experience has of course led to improvements in design and operation of retarders, and has taught the minimum requirements necessary for working a yard consistent with efficiency having regard to the traffic it is called upon to deal with, etc. It is, however, in the scientific design of the lay-out that the greatest advantages have accrued compared with earlier designs and this can best be exemplified from the illustration (fig. 14) of a yard opened for retarder operation in 1928.

This particular yard, which possesses 36 classification tracks is served by 17 retarders in 10 locations only. This has to a large degree been rendered possible by the replacement of the « ladder » system of sidings by sidings of the « balloon » type with the points or switches leading to the sidings at more or less equal radii from the top of the hump.

It will be seen from the diagram that there is a single lead off the hump fitted with two combined retarder units totalling 75 feet (25 yards) in length. To obtain high switching capacity a quick separation of cars on to many diverging routes is essential, with a minimum of travel to the clearance points on each classification track, which minimizes the difficulties incident to different rolling qualities of various types and weights of cars. At a distance of 126 feet (42 yards) from the crest of the hump, therefore, there is a « junction » switch opening out to three routes. Each of these is again divided into two routes at a point 189 feet (63 yards) beyond the junction switch and 315 feet (105 yards) from the crest of the hump. Just short of these latter switching points a single retarder unit 38 ft. 6 in. is located. These six diverging routes each serve six of the classification sidings and on each are two combined retarder units totalling 77 feet (26 yards) long. This is the extent to which retarders are provided and the maximum distance from the junction switch to the most distant classification track is 595 feet (198 yards) and from the crest of the hump 721 feet (240 yards approx.).

This comparatively large reduction in the number of retarders materially lessens the cost of installation, maintenance and operation.

All-electric retarders.

As previously explained, the retarder consists of a series of metal shoes suitably mounted in the form of a continuous beam one on each side of the running rail and generally duplicated on both running rails. The position and action are best indicated in the accompanying diagram of a cross-section (fig. 15).

Each retarder is operated by a direct current electric motor through the medium of a suitable gear reduction and operating mechanism. The retarder motors are controlled by heavy duty contactors located at the retarders which in turn are operated by a lever or switch in the operating tower, over a control cable running from each lever direct to each retarder and carrying only the light current necessary for the control of the

contactor. The motors and the normal and reverse contactors are specially designed for quick starting and stopping and each motor is equipped with a powerful brake so connected and arranged as to hold the motor stationary except

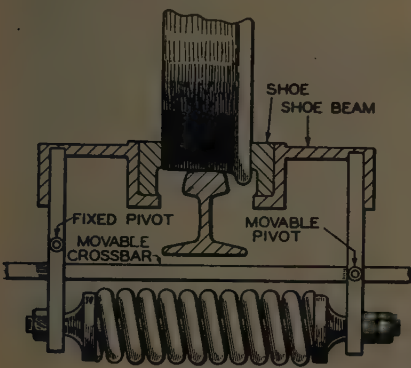


Fig. 15. — Cross section of retarder.

when power is applied to operate it. The small levers in the operator's tower for the control of retarders operate to five positions in the particular type under review, one position being open while the other positions provide for four different degrees of retardation.

Improvements continue to be made and the latest available information respecting the most recent all-electric design of General Railway Signal Co. retarders, such as installed at Mechanicville is that they are of extra heavy construction, with the springs below the rail and protected by a heavy plate. The pressure is equalized on both sides of the car wheels, the retarders on each rail acting independently. This is said to allow for variation in wheels, and further, if a car is lifted in the retarder by excessive pressure it continues to roll with the flange guided by the retarders but above the line of pressure. As a result the lifting of a car through an error of judgment does not tend to derail it, the retarder simply holding it over the rail as will be appreciated from the cross-section drawing already illustrated (fig. 15).

These particular shoes are made of rolled steel fastened by heat-treated nickel-steel screws accessible from the top of the shoe beam.

Electro-pneumatic retarders.

In outward appearance there does not appear to be a great difference between this type and the all-electric, and similarly improvements in design continue to be made. According to latest available information a new model by the Union Switch & Signal Company incorporates greater power strength and flexibility than previously.

Each retarder unit, electrically controlled from the operating towers, is actuated by an air cylinder, the outward motion of the piston providing the necessary braking force. The pressure in the cylinder, and hence the extent of retardation, automatically follows the position of the control lever. Thus the retardation of a car may be increased or decreased from any one of four pressures to any other. The last position of the control lever sets up full cylinder pressure and an automatic change of piston stroke is provided on this last position. This change of piston stroke, when not more than two pairs of wheels are in the retarder, permits advantage to be taken of the full strength of the springs, and automatically eliminates any re-action on the piston, but without sacrifice of the equalizing and centering feature.

The leverage system of this particular

type is understood to equalize the pressure between the inner and outer brake shoes, thus keeping the centre line of a car over the centre line of the track. It is stated that if, from a misjudgment on the part of the operator, a car is lifted from the rails, this centering feature results in the wheels dropping into proper position on the rails when the car leaves the retarder.

Another important feature of this type is a special arrangement of the brake beams which causes them to rise about an inch as the brake shoes grip the wheels. The shoes rise with the beams and gain an additional leverage which increases the retarding effect. This is obtained without loss of clearance since the shoes are raised only after they have engaged the wheels.

Fig. 16. — Recent pattern covered in car-retarder.

All working parts are covered, protecting them from dirt and weather and avoids damage if a car is dragged over the retarder on account of a derailment outside of it.

A full view of this covered retarder is given in figure 16.

The brake shoes used in the apparatus of the Norfolk and Western Railway at their Portsmouth East yard are of manganese steel but no information has been supplied as to costs.

An illustration of a car wheel in the retarder is given in figure 17.

Car-retarder yard lay outs and grad ents.

From what has previously been described it will be appreciated that modern retarder-yard methods necessitate the balloon-shaped formation with the points or switches at more or less equal radii from the hump if the work is to be carried out in the most efficient and expeditious manner.

It is of interest to note that this forma-

tion seems to have been considered as the most suitable for shunting yards generally, almost before the advent of car-retarder methods, *vide* article No. 15 of

Fig. 17. — View of car wheel in retarder.

Final Summary of Reports on Shunting Yards, London Session 1925, which is quoted below :

15. — The distance between the top of the hump and the set of points nearest to the head of the sidings should be as short as possible. The lay-out of the head of the sidings should be such that there is no great difference between the resistances offered by the different roads, that the distance between the points at the head of the group of sidings and the fouling points should be reduced to a minimum, and so far as possible the same for all the roads.

If necessary, the head of the sidings can be given a sufficient incline to overcome resistances due to curves and reverse curves.

Considerable difference of opinion as revealed in practice has existed in the past with the result that there are many yards with the ladder or grid formation which is a disadvantage when the question of installing car-retarders comes to be considered.

With regard to gradients, it is doubtful whether any general standard can be laid down in the case of non-mechanically operated yards, as much depends upon the nature of the lay-out through the point or switching area, the prevailing winds and the fact that movement generally is slower in cold than in warm weather.

Where rail-braking methods of the car-retarder type are adopted, the principle in regard to the gradient off the hump is relatively simple. The falling gradient must be sufficiently steep to permit of the worst running car or wagon travelling the longest necessary distance, under the least favourable conditions as regards curvature of the track and weather.

It is found that this necessitates a primary falling gradient of about 1 in 18 to 1 in 25, followed by a length about 1 in 50 or 1 in 60 approximately at the bottom of which the retarders are situated in the case of single retarders as at Whitemoor, London & North Eastern Railway. Where retarders are fixed in series as in the United States, there may be some located beyond the gradients mentioned above, according to the method of location adopted, but primarily the governing principle of a comparatively steep descent from the top of the hump applies. Such steep gradients are not and cannot be adopted at other than car-retarder yards.

The principle as regards the relation of gradients to the retarder and point areas is well illustrated in the diagram of Whitemoor Yard, London & North Eastern

Railway, *vide* figure 11. It will be seen that there is a fall of 1 in 18 for the first 50 yards from the crest of the hump followed by a down grade of 1 in 60 for 70 yards, following which is a slight fall until level is reached. A rising gradient of 1 in 300 at the end of the sidings is just sufficient to obviate any tendency for wagons to run out at the extreme end.

As previously stated the worst running wagon under the most unfavourable conditions is the ruling consideration, all other wagons requiring to be braked by means of the retarder in suitable proportion to their running capacity and the distance they require to be allowed to run into the sidings.

In the case of Whitemoor it will be seen that the reception sidings are on a rising gradient of 1 in 246 until within a short distance from the hump, when for a short portion the rise is more pronounced. Such an arrangement necessitates the employment of propelling engines for the whole of the humping but this is more or less inevitable owing to ground levels in the locality. Where the nature of the levels permits it would appear to be an advantage for the reception sidings to be on a falling gradient with just sufficient rise short of and over the hump to slacken the couplings for the purpose of unhooking.

In such instances consideration may be given to the provision of a single retarder short of the hump to control the natural movement of a train towards the hump. Where such an arrangement can be instituted some economy in regard to propelling engines should be possible.

Power operated skates.

It will be noticed from the summary of car-retarder installations in the U.S.A., table II, that at many of the mechanically operated gravity shunting yards, power skates are provided in addition to retarders. These rail skates form a supplementary means of retardation, and where used one is usually fixed beyond the last retarder, so that each siding or classification track is furnished with a means of supplementing the efforts of the retarders if for any reason a car is running at an excessive speed after leaving the last retarder.

The skate is a shoe which, when in place on the top of the rail, allows the car wheel to roll up on a part of the skate. Afterwards the skate slides along the rail, the friction providing the means of stopping or lessening the speed of the car. It is operated on and off the rail either by an electric motor or by pneumatic power, as in the case of the retarder, and similarly is electrically controlled by small levers in the operators' tower.

The shoe proper is so fastened to the operating mechanism that it may be thrown on and off the rail without disengagement, and yet is so attached that the car will pull the skate away without damage to the mechanism. This permits an operator to test out the skate machine without the need of restoring the skates by hand.

The distance at which the skates are located beyond the last retarder depends entirely upon circumstances but generally speaking they are not placed on any curved portion of track, and may be regarded as more or less a brake for emergency purposes only. Generally they are placed on one rail only, and no deleterious effect on rolling stock is reported in consequence of their use.

It is not clear from reports received whether, on coming to a stand, a car will roll back off all types of skate and liberate it or whether it has to be backed to

release it. In any case there seems to be no mechanical arrangement for returning the skate to its placing mechanism and, therefore, they have to be carried by hand to their starting point.

One particular type, however, patented by Robert E. McGahey, Master Mechanic, and put into use several years ago at the Potomac yard of the Richmond Fredericksburg & Potomac Railroad, is described as an automatic self-releasing car retarder. It is in the form of a shoe or skate and can be operated electro-pneumatically or manually and can be used in flat as well as gravity shunting yards.

Broadly, the method of operation is as already described, and in this particular instance there is a device which causes a small light to be exhibited in the operators' tower when the retarder skate is actually on the rail, which feature is very useful for night operation where the stops are used at distant points.

A sand pocket is formed in the head or body of the casting in which sufficient sand can be placed for several days. The sand falls through a perforated plate when the stop is in position on the rail. The purpose of this is to increase the friction between the car wheels and the rail.

The shoe is automatically released by the car rolling down the incline from the shoulder.

Figures 18 to 20 shew position of a car which has been brought to a stand and has rolled back off the shoe and illustrate the placing mechanism in the « on » and « off » position.

The idea of the shoe or skate renders it practicable apparently to make use of it for establishing the head end of trains.

Whilst the use of shoes in their proper sphere is no doubt advantageous, inasmuch as the comparatively slow rate of speed at which a car will run after leaving the last rail brake enables effective use to be made of them when necessary, there does not seem to be, owing to the heavy cars and loads in the United States, any opening for a solely skate installation.

Control towers.

The highly concentrated method of control of the car retarding and switching apparatus renders it essential that the comparatively few men needed for this essentially « key » position should be properly located and suitably housed. The general arrangement is for a tower or elevated cabin to be constructed in such a position and at such a height that the operators can have, both by day and by night, a clear and uninterrupted view of the hump and of the retarders and switches in addition to a bird's-eye view of the whole yard.

Control of the car retarding and switching mechanism is, generally speaking, effected by small levers mounted on a sloping panel. One row of levers will control the retarders and those on another row the switches. A further row of levers will control the skate placing mechanism where provided.

The number of towers varies according to circumstances and in the United States car retarder yards is anything from one to five. In the earlier designs the layout of the classification tracks is more of the ladder formation and where the number of retarders is considerable, the number of operating towers is consequently greater. For example, at the Blue Island yard, one of the earliest retarder humps, there were five towers operating the movement on to 30 tracks, *i. e.* one tower to six tracks.

Figs 18 to 20. — Track skate, Potomac yard.

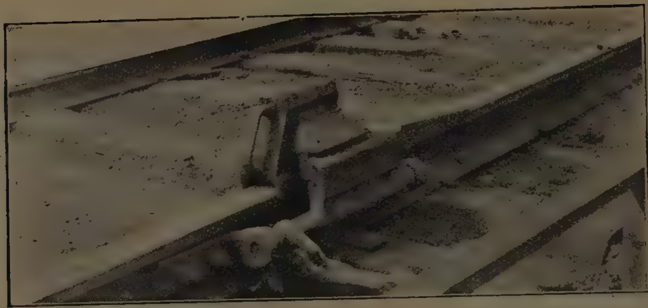


Fig. 18. — General view (skate on rail).

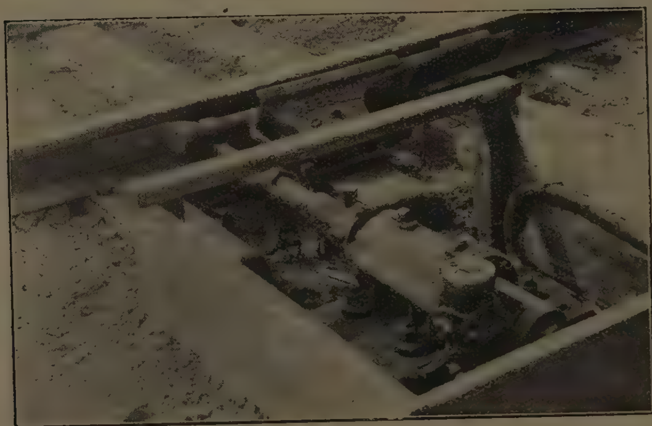


Fig. 19. — In rest or normal position.

Fig. 20. — In use.

With the more modernized layouts on the « balloon » principle the tendency is for operations to become more concentrated with consequently a lesser number of towers. The extent to which this minimization of the number of towers can be effected is finally governed by the amount of traffic requiring to be dealt with.

At one yard dealing with about 1 100 cars per day, there are two operating towers and 36 classification tracks. Tower « A » controls the main incline switches and retarders, plus the switches and retarders on twelve tracks, whilst tower « B » controls the switches and retarders on 24 classification tracks. Summarized, therefore, tower « A » controls 9 retarder units and 15 switches and « B » 8 retarder units and 20 switches. The control machines were designed for operation by one man in each tower, combining both retarding and switching, but so arranged that two men could be used in peak periods. Whilst the net amount of work is probably evenly divided between the two towers, the arrangement of division of point areas and retarders makes one operator responsible for the throughout process in the case of 12 tracks but as regards the other 24 the throughout movement is divided between tower « A » and tower « B ». The amount of traffic handled no doubt permits this to be accomplished satisfactorily. It is stated that within a month of opening, with one man in each tower, 125 cars an hour could be humped and with two men in each tower, 250 cars an hour.

At the Portsmouth hump yard of the Norfolk and Western Railroad there are 36 classification tracks and only two operating towers. The retarders and switches in the immediate vicinity of the hump are controlled from one tower and all the remainder of the retarders and switches, *i. e.* those at the commencement of the classification tracks, are controlled from another tower situated in the centre of the point area.

This latter tower contains two control panels, one controlling broadly one half of the classification tracks and the second the other half. The lay-out of the track and the location of the tower are such that the retarding and switching work for the whole 36 classification tracks can be conveniently undertaken from this one tower, thus virtually avoiding the necessity for another tower which a more scattered lay-out would entail.

An analysis of the functions controlled from the two towers at Portsmouth is given below :

	Tower N° 1.	Tower N° 2.		Total.
	Panel N° 1.	Panel N 2.	Panel N° 3.	
Retarders	12	11	11	34
Switches	9	23	12	44
Skates	0	22	15	37

The controlling apparatus at Portsmouth, except that in tower No. 1, which does not have any skate control levers, consists of four rows of control levers mounted on a sloping panel. The two middle rows of levers control the retarders and those on the top row control the skate placing mechanism. The bottom

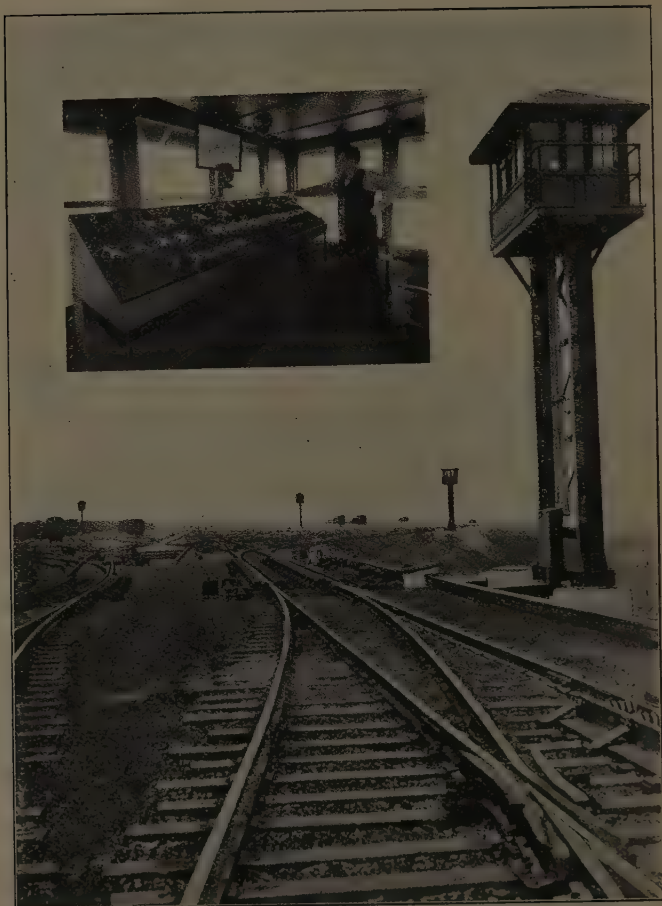


Fig. 21. — Typical control tower, etc

row of levers control the power operated switches, and directly above these is a row of red and green lights to repeat the normal and reverse indications of switches.

The towers are of steel construction and are accessible from the ground by stairways. They are glass enclosed on all sides in order to give each operator a clear and unobstructed view of the area under his supervision.

Figure 21 gives a general view of a

typical control tower, and inset is an illustration of the interior shewing the control panel and levers, also microphone for loud speaker, etc.

Means of communication.

It is only natural that a highly concentrated form of yard operation should require adequate facilities of inter-communication between the staff engaged in the respective processes and no yard without suitable telephone circuits can be considered complete.

In modern forms of mechanically operated gravity shunting something more than this is required and the following is an outline of the special facilities, some or all of which are provided at such yards in the United States.

In the first place it should be explained that information as to the composition of every train requires to pass between the guard or conductor of a train on arrival and the office of the yardmaster or other appropriate official. It may here be stated that this is the usual practice at all large American yards, whether mechanically operated or not, for the purpose of enabling switching lists to be prepared.

In Great Britain it is not the general practice to prepare switching lists, all loaded wagons bearing a suitable label indicating destination and empty wagons not otherwise specially labelled are readily identified by their ownership or suitable instructions as to destination being painted on them. The foreman or shunter responsible cuts or breaks up a train without the necessity for preparing shunting lists, *i. e.* the number of the siding for which intended is chalked on the wagon or otherwise indicated to the pointsmen and brakesmen concerned.

Under rail braking conditions on any extensive scale no matter in what country introduced, the making out of switching lists seems to be an essential feature. In view, therefore, of the time which must be allowed for performing this clerical work and circulating the completed working lists to the retarder, etc., operators in the towers, it is desirable the time required in the process of transferring train lists, waybills, etc., from the conductor of a train to the yardmaster's office (often situated in the vicinity of the hump for general convenience of supervision) should be reduced to a minimum, particularly as the walking length of trains is considerable.

The most expeditious method of doing this, and one less costly in the long run than by employing messengers, is by installing a pneumatic tube between a convenient spot somewhere at the entrance to the reception or arrival lines and the yardmaster's office so that the conductor or guard can despatch them to the yard office immediately on arrival.

This method is in use at a number of modern mechanically operated yards and would appear generally to meet requirements.

With regard to the question of telegraphing the composition of a train ahead *i. e.* from its last traffic stopping place, it is not seen that really useful purpose is served thereby, except perhaps in certain circumstances. Apart from heavy occupation of telegraph wires which it would entail, there would not in all instances, especially where the flow of traffic is of a multi-directional character, be any satisfactory degree of certainty as to the relative order in which trains would arrive, and the uncertainty of knowing beforehand the extent of the occupation of the classification tracks (which at a busy yard has to be tempo-

rarily altered at short notice sometimes) would defeat the object.

The waybills, etc., having been received in the yardmaster's office, it is necessary to disseminate to the staff concerned information as to the composition of a train on arrival.

Various methods of doing this are in force. One method is to prepare a switching or cutting list or card, copies being multiplicated as necessary. These documents can be despatched from the yardmaster's office to the rail brake and point operators in the tower or towers, to the man in charge of humping operations, and the uncouplers, either by means of messengers or through pneumatic tubes.

Another practice is to install electric teletype machines whereby as keys are depressed in the yard office the corresponding information is printed on paper and repeated in the one operation at all the necessary places where personnel concerned are located and where other teletype machines are installed. For speed of transmission of the requisite information, it would appear that this method cannot be improved upon, but no data is available to shew the degree of reliability of the apparatus employed as compared with the transmission of the actual cut lists by hand or pneumatic tube.

At one of the typical retarder yards in the United States the actual arrangement is, on arrival of the waybills, etc., in the yard office for the cars to be classified as to destination and loading. The teletype operator transmits particulars of the arrival track, the railroad from which the train was received, the engine number, the conductor's name and the date and time of arrival. This is followed by a list shewing each car in the order it appears on the train, the first car on the list being the first to go over the hump, *i. e.* first the number of the cut and then the number of the car. This is followed by one of five symbols designating the car number, *i. e.* « E » for empty, « LL » up to 40 000 lb. net, « L » between 40 000 and 100 000 lb. « XL » between 100 000 and 115 000 lb. and « XXL » above 115 000 lb. The last column shews the destination of the car in abbreviated or code letters and enables the retarder operator to place the car or cars on the proper track. So far as the retarder operator is concerned it is seldom necessary for him to take time to identify the actual car number, but the information as to loading, *i. e.* weight, is essential for the proper operation of the retarder units as the amount of retardation depends almost directly upon the weight of the car and load.

In order to ensure a proper understanding loud speaking telephones are provided between the operators' towers and other key positions as necessary, thereby enabling the speedy transmission of verbal instructions and messages. Communication between the retarder and switch operators in the control tower on the one hand and men stationed for various duties in the classification track area can best be decided according to local circumstances.

The use of wireless apparatus does not appear to have developed on any appreciable scale in connection with humping operations either for code ringing or as a means of verbal communication. Whilst alluding to this question, the following which the liberty is taken of quoting from *Westinghouse International* for February-March 1929, may be of interest :

Radio between engine and caboose.

Two locomotives ahead, and three behind, were slowly starting a 131-car

train weighing 9 601 tons. The front end had been going two minutes and a quarter before the rear end moved, and a towerman, not realizing that the long string was under way, signalled a light freight train to pass it. The head engines set the emergency air, called for brakes. The three rear engines, a mile and a quarter away, pushed steadily ahead. A wreck was certain. But the head engineer remembered the newly installed train radio, snatched the transmitter and called the caboose. The three rear engines quit pushing, went into reverse. The 9 601-ton train stretched, stopped, cleared the light freight by a few feet. This happened this year. Similar incidents will occur again, for radio telephony on trains ceased this year to be experimental. The Chesapeake & Ohio operated with this equipment for a three months' trial period early in the spring. The Pennsylvania made a two-month' test in the summer. 1929 will see commercial installations on several roads.

Lighting of yards.

Good lighting in a mechanically operated gravity shunting yard is essential. The most efficient method of modern illumination is known as « flood-lighting ». The basis of this method is that the light is thrown in an almost horizontal or sloping direction as distinct from the hanging arc lamp which throws the light downwards.

The U. S. A. Markham yard for instance is lighted by batteries of flood lights, placed on steel towers located in strategic positions. The towers are from 90 to 120 feet high and the light projectors on each tower vary in number. The equipment consists of « Pyle-National » projectors fitted with what are described as G. 40, 110-volt, 1 000-watt concentrated filament, small divergence lamps with uranium glass reflectors. There are about eight towers, each carrying anything from three to nine projectors which light the whole of the strategic points on the receiving, classification, and departure tracks of both the Northbound and Southbound Markham yards.

As an illustration of the manner in which the flood light projectors are located, it may be mentioned that on one lighting tower close to the top of the Southbound hump there are two projectors facing the receiving tracks and six casting light over the entrance end of the classification tracks which number 42. The latter battery of projectors lights the whole of the point or switch area and the numerous retarders.

Local lights are installed as required but the flood lights illuminate clearly by night the important working parts of the yard, so that the car-retarder and switch operators in their control towers have clear vision of the movement of cars over the hump, through the switches and retarders, in addition to which they can readily see the extent to which the classification tracks are occupied.

As previously stated the towers are glass enclosed and it is of interest to note that at one U. S. A. hump yard at least the framework of the windows including the corners of the cabins is made as narrow as practicable so as to render the view of the operators as unobstructed as possible.

The form of flood lighting described above is understood to be known as the « parallel opposing » method of group lighting and the flood light beams are projected parallel to the tracks as far as possible.

Another method, but involving more space for poles or towers with relatively higher cost of installation and mainten-

ance is known as the « uni-directional » system of distributed lighting. The lights are located at suitable intervals and in such positions that they project the light slightly diagonally on the area to be illuminated.

The importance of good lighting applies to all forms of yard operation but the necessity for it at car-retarder yards is particularly essential where there is no form of track circuiting in conjunction with an illuminated diagram in the operating tower to indicate, as at Feltham on the Southern Railway, England, whether a wagon is standing foul of or has cleared the point or switching area.

The advantages of efficient lighting are the speeding up of work generally and the avoidance or minimization of damage and personal injury.

There is much in regard to the question of lighting that must be left to the electric lighting experts but from a traffic operating standpoint the avoidance of glare, the non-interference with the vision of colour light signals and the conversion of night into daylight as far as it is practicable to attain this, are desirable features. Modern forms of electric flood lighting provide the nearest approach to the ideal.

Point or switch operation.

As stated earlier the operation of switches or points at car-retarder yards in the United States is effected electrically or electro-pneumatically.

With comparatively few exceptions the operation of points at marshalling yards in Great Britain is effected purely mechanically, either by means of levers in close proximity to the points, or by levers located at a stage or cabin at varying distances away, and connected to the points by iron rodding or wires.

At several yards, however, electricity is utilized for this purpose and perhaps it will not be out of place at this juncture to describe the arrangements at one such British yard, *i. e.*, Feltham, where the Southern Railway have a modern well equipped hump yard with separate Up and Down direction humps. The points leading to the sorting sidings are operated electrically, there being press buttons on a diagrammatic operating board in the respective pointsmen's cabins. These boards are on a sloping table, all tracks being clearly shewn, with one or more small indicating lights at the various points and two press buttons, differently coloured, in each pair. The actual points move over almost instantaneously as one or other of the buttons is pressed, according to the direction required. A small coloured marker light remains illuminated as long as the corresponding points are fully over one way or the other. As the points change it is extinguished but as soon as the tongue is fully home it becomes illuminated once more. Other light indications, red and green, shew the occupancy or not, of the entrance portion of each siding, red shewing as a shunt runs down over the track circuited portion, being replaced by a green light when the wagon or wagons is or are clear of the track circuit, and therefore well down the siding.

The actual method of working is as follows. The engine pushes the train of wagons to be split up at about 1 mile an hour up the hump. The first wagon has chalked upon it the number of the road in which it is to run, and this is observed by the pointsman who sets the road by pressing the buttons as required upon his diagrammatic operating board. As this wagon passes him he observes the number chalked upon its rear end, and

this tells him which road is required for the next shunt. In fact, after the first wagon has been dealt with, the pointsman does not require to pay any attention to the train which is being dealt with, but only to observe the number chalked upon each shunt as it passes him and to set the road accordingly as soon as it clears the points. A powerful electric lamp is provided at one corner of the cabin so that the numbers in chalk can be seen after dark, its rays being directed so as to show these up at the most convenient position for observation.

Signalling during shunting operations.

The process of shunting operations necessitates a code of signalling of as simple a character as possible between the shunting staff and the enginemen.

The method of colour light signalling adopted at retarder yards has already been described and this arrangement would appear to be worthy of further consideration in connection with shunting at hump yards generally. It can be used either as a single unit or duplicated or triplicated along the reception lines, *i. e.*, the lines leading to the hump, and may be accompanied by electrically worked horns to attract the driver's attention.

In connection with shunting operations generally at yards and stations in Great Britain the arrangement at all except the larger places is for the shunter to signal to the driver during the hours of daylight by holding or moving his arm or arms in certain positions.

During the hours of darkness the instructions in force on a typical British Railway Administration are quoted below :

Shunting signals by night. — In shunting operations by night, or when necessary in foggy weather or during falling snow, a white light waved slowly up and down means « Move forward », *i. e.*, go away from the person giving the signal; a white light waved slowly from side to side across the body means « Move back », *i. e.*, come towards the person giving the signal.

A green light used instead of a white light as above means « Move forward slowly » or « Move back slowly ».

Supplementary instructions in connection with the use of whistles or horns are laid down by the London Midland & Scottish Railway for the guidance of their staff concerned and are quoted below for information :

Signalling during shunting operations. — The following is the code to be given by gongs, bells, whistles, or shunting horns for the purpose of signalling to drivers during shunting operations :

Go ahead	One.
Set back.	Two.
Stop	Three.
Ease couplings	Four.

The ordinary mechanical semaphore signal with « on » and « off » positions, with corresponding lighting at night, is used at some of the large hump yards — the semaphore being mounted on a post of suitable height and manipulated by the shunter or other person in charge of humping operations.

A special arrangement is in force at the Feltham Yard on the Southern Railway as follows : Near the summit of each hump a device is fitted whereby, should need arise, the shunter in charge can return the hump shunting signal to « danger », independently of the signal cabin, and if this occurs the driver takes it as an intimation that he must stop immediately. An electric syren is also provided to call the driver's attention to the

change in the position of the signal which controls his progress to and over the hump. As the signal is pulled off, one short blast is given; when replaced to the « on » position one long blast is given. If it is desired to instruct the driver to increase speed over the hump, three short blasts are given.

Some means of indicating to the men operating the points the siding or track for which a particular wagon or cut of wagons is intended, is necessary, and various practices are in force.

There is the practice at small yards or fans of sidings of shouting or calling out the number where the distance between the men concerned is not excessive. Megaphones can be and are used as considered desirable.

At other yards there may be purely local codes whereby the men express the number of the line by various positions of their arm or arms. To the onlooker the proficiency with which this somewhat crude method of signalling is often carried out is surprising. This is of course a daylight operation only and at night has to be replaced by a frequently elaborate code of signals by means of a hand lamp capable of shewing white, green and red. This method works satisfactorily amongst men accustomed to it, but it is not altogether an ideal arrangement where code signals are numerous.

A further method is to chalk on the end of a wagon in a suitable position, or actually on the buffer, the number of the siding for which intended. This may be either on the front of the wagon as it approaches the pointsman or the number for the second cut may be placed on the rear of the first cut as it approaches him, according to local arrangements.

At several places, few comparatively in number, special indicating apparatus is installed. The Great Western Railway at their Bristol East Depot have at the hump an apparatus whereby a plug placed in a hole corresponding to the number of the siding repeats the number on a suitable indicator to the pointsman.

The London Midland & Scottish Railway at their Aintree outwards marshalling yard, where the contour almost unavoidably necessitates the points being somewhat scattered and where two pointsmen's cabins have to be provided owing to the distance the farthest points are away from those nearest the hump, have an electrical indicating apparatus whereby when a button corresponding to the number of the siding is pressed in a small cabin situated quite close to the hump, this number is repeated on an indicator in the pointsmen's cabin concerned. The indicator is fixed on a shelf immediately over the point levers, and is in the nature of a picture frame divided into squares. On the consecutive squares are permanently marked the individual numbers of the sidings and when the press button in the hut at the hump is pressed, the siding number in question becomes illuminated, and a buzzer or bell rings simultaneously. The light goes out and the bell ceases ringing immediately pressure on the button at the hump end is relaxed. There is a press button in both pointsmen's cabins which rings a bell in the hump cabin. In actual practice the pointsman acknowledges siding numbers by a short ring on this bell, which can of course be used for other code ringing purposes. There are occasions when several wagons or cuts of wagons are on the move from the hump through the point area at the same time, thus necessitating the pointsman concerned memorizing temporarily the sequence of siding numbers affected, but no difficulty is experienced.

There does not appear to be, up to the present, any extensive development of the use of illuminated signs visible by shunters and pointsmen in whatever position of the yard located, and giving the number of the siding for which a shunt is destined. Presumably at the smaller yards the present arrangements suffice, and at the large yards where several cuts of wagons may be on the move through the point area at any one time, a single visible number might cause confusion. Moreover, to be visible from the parts of the yard concerned the indicator would have to be at such a height that it would occasionally be obscured by smoke from engines, and completely out of sight in anything but very slight fog.

The use of loud speaker apparatus with a microphone at the hump or throat of the sidings and loud speakers fixed in several positions as necessary does not appear to be in anything like general use, if at all, and it is suggested there might be scope for something of the kind both for conveying siding numbers and other information.

Conclusion. — Rail braking.

If it is accepted that hump or gravitation shunting is the ideal arrangement for sorting wagons at the larger marshalling yards (and there seems to be no reason to doubt this provided conditions as to contour, space, layout, etc. are satisfactory, and the amount of traffic to be dealt with is sufficient to justify it) the question as to the most efficient and economical means of braking or retarding the vehicles is a natural corollary.

It is well known amongst those concerned with this form of traffic operation in particular that much thought and time have been expended by both practical railwaymen and theorists in bygone years with a view to evolve some simpler, cheaper and safer means of controlling the speed of wagons gravitating into sidings.

So far, however, as the countries embraced in this report are concerned, it would appear that the credit belongs to Mr. George Hannauer, when Vice-President of the Indiana Harbour Belt Railroad, in conjunction, it is understood, with Mr. E. H. Wilcox, then master car builder of the same line, for having been the first to develop to a stage of practical accomplishment a system of braking or retarding wagons or cars without the necessity of men accompanying them in the process of their descent — a system which represented the first and only departure, generally speaking, from the manual hand braking methods in force during the century old existence of railways.

This particular system, *i. e.* rail braking, first commenced in the United States in about 1923, is still comparatively in its infancy, although considerable improvements have been made in subsequent installations amounting to about 20 in that country.

The fact that, in no other country in North or South America, nor in Asia, Africa, Australasia, nor in Great Britain (with one exception) has this retarding arrangement been introduced, naturally leads to a certain amount of speculation as to the cause.

Enough has been said in this report to indicate that the costly « car-rider » problem in America doubtless gave the impetus to the birth of the practical scheme, but the obvious question is as to why methods on a similar basis cannot be introduced elsewhere with economical advantages.

The first consideration, and an impor-

tant one in these days of post-war trade depression and road competition, is that of cost of installation and maintenance and whether the economies and advantages to be derived are commensurate with outlay and maintenance charges. This is a point in regard to which detailed information is not available, but in any case it would be difficult to compare usefully American and British figures under this head. It was, however, reported at the Annual General Meeting of the London and North Eastern Railway (England) in March 1928 that the estimated cost of providing their entirely new Whitemoor yard and installating the « Frölich » system of rail braking and point operation would be about £285 000 but details as to how this is made up are not available.

With regard to the savings to be effected by the introduction of car-retarders these would mainly be the outcome of abolishing « wagon-steadiers » or « car-riders » where employed, and in the nature of things there is not the economy to be derived from « wagon-steadiers » that there is from « car-riders ».

Further economies are obtainable under certain conditions (but not in every case) by speeding up work at sorting sidings and decreasing the period wagons are perforce held in such sidings. Also it has been found possible in the United States in one or two instances to curtail the number of shifts or tricks, *e. g.* by compressing into two shifts work which hitherto entailed three shifts. Moreover, such an increase in the capacity of a yard enables work hitherto performed at a number of smaller non-mechanically operated yards to be concentrated at one retarder-yard with consequent reductions in current operating and standing charges.

Whilst the major economies to be derived are in the direction of reduction in the number of employees, the extent thereof naturally depends upon the capacity of the yard and the amount of business handled. In addition, however, there are other advantages and economies to be considered, such as :

1. The ability to keep a yard open and functioning under all weather conditions.
2. The elimination of tracks, speeder-cars or motor cars and in some instances expensive concrete subways for returning riders to the hump, and the utilization of such tracks as additional classification tracks.
3. Damage to lading and equipment through rough handling is considerably reduced.
4. Personal injuries reduced
5. Less extra switching required as cars with defective hand brakes can be humped direct to « bad order » tracks instead of being associated with a good order car which later has to be shifted from the bad order track.

The second consideration is the number of cars or wagons dealt with normally at a particular place, or the number which by re-arrangement or transfer of work from other places would fall to be handled.

In the United States the economies to be derived from the abolition of car-riders, etc., are so considerable as would appear to justify the installation of car-retarding apparatus at yards where the number of cars to be humped is less than would justify the installation of similar apparatus at hump yards in other countries where car-riders are not employed.

In fact so satisfied apparently are some of the administrations in the United States with car-retarders that they are in use at yards where less than three tricks or shifts per day are employed. Moreover, at least two private firms or public utility undertakings possessing private railroads or sidings are understood to have installed car-retarders. For instance the Commonwealth Edison Company is reported to have a small car-retarder layout at one of its power plants in Chicago to assist in handling coal cars.

In the circumstances, therefore, no useful purpose would appear to be served at this juncture by quoting figures of cars handled daily at the car-retarder yards in the United States, even if available. It does nevertheless seem unfortunate that for purposes of general comparison, there does not appear to be any official publication giving the number of wagons dealt with at, and other operating statistics relative to, the principal marshalling yards in the U. S. A. somewhat on the lines of the figures published by the Ministry of Transport in England of performance at the principal marshalling yards in Great Britain for the months of February and August each year.

Although experience of car-retarding apparatus in Great-Britain is, up to the present, somewhat limited, it would appear from preliminary investigation that, with the type of apparatus at present available, there is an economic limit in the matter of wagons handled daily below which the installation of a complete car-retarding apparatus would not be justified. What this economic limit will finally resolve itself into may depend to an extent upon the experience of the London & North Eastern Railway at their new Whitemoor yard, the first installation in Great Britain, and it is not possible to give any useful data on this point as up to the time of writing the yard has not been formally opened.

Whitemoor is an entirely new yard and no data is yet available as to the cost of converting an existing hump yard into a mechanically operated one. This is an important consideration as few, if any, existing layouts would conform without some alteration to the scientific requirements of a braking apparatus.

The London Midland & Scottish Railway are considering the question of altering certain of their existing large marshalling yards. Plans are in an advanced stage but a decision has not yet been reached.

Appended hereto is a summary, table III, shewing the administrations in the countries under review which have replied to the questionnaire circulated and indicating :

1. Those not possessing any hump or gravitation yards.
2. Those possessing one or more humps or gravitation yards.
   a) Not equipped with car-retarders.
   b) Not equipped with car-retarders but question of installation stated to be under consideration.
3. Those possessing one or more hump yards with car-retarding apparatus.

Although little specific reference has been made herein to other than British and United States administrations, those in the other countries under review, including British Colonies, Dominions, etc., South America, Japan and China have not been overlooked in the process of compiling this report. Whilst some interesting data has been received from them, parti-

TABLE III

Summary shewing the administrations which have replied to questionnaire.

(Heading applicable indicated by ×).

Country.	Name of administration.	Have one or more hump or gravitation yards. Equipped with car retarders.	Have one or more hump or gravitation yards. Not equipped with car retarders.	Possess no hump or gravitation yards.
Argentine.	State Railways	...	...	×
	Buenos Ayres Great Southern	...	...	×
	Buenos Ayres Western	...	...	×
	Buenos Ayres & Pacific	...	...	×
	Cordoba Central	...	...	×
Chili.	Nitrate Railways	...	...	×
China.	South Manchuria	...	...	×
Africa.	Gold Coast Government	...	...	×
	Kenya & Uganda	...	...	×
	Beira & Mashonaland & Rhodesia	...	...	×
	Nigerian	...	...	×
	South African	...	...	×
	Sudan Government	...	...	×
Australasia.	New South Wales Government	...	×	...
	New Zealand Government	...	× (A)	...
Canada.	Canadian National	...	×	...
Ceylon.	Ceylon Government	...	...	×
India.	Bengal Nagpur	...	×	...
	Bengal & North Western	...	...	×
	Bombay, Baroda & Central India	...	×	...
	Eastern Bengal	...	...	×
	Great Indian Peninsula	...	×	...
	Madras & Southern Mahratta	...	×	...
	Rohilkund & Kumaon	...	...	×
Mesopotamia.	Iraq State Railways	...	...	×

N. B. — (A) Question stated to be under consideration.

Country.	Name of administration.	Have one or more hump or gravitation yards.		Possess no hump or gravitation yards.
		Equipped with car retarders.	Not equippsd with car retarders.	
Japan.	Government Railways	...	× (A)	...
	Government General of Chosen	...	...	×
Uruguay.	Central Uruguay	...	...	×
Malaysia.	Federated Malay States	...	...	×
Great Britain.	London Midland & Scottish	...	× (B)	...
	London & North Eastern	× (C)	×	...
	Great Western	...	×	...
	Southern	...	×	...
	Great Northern of Ireland	...	...	×
	Metropolitan District	...	...	×
United States.	Bessemer & Lake Erie	...	...	×
	Delaware & Hudson	...	×	...
	Lehigh & New England	...	×	...
	Lehigh Valley	...	× (A)	...
	Long Island	...	×	...
	New York Central	×	...	...
	Norfolk & Western	×	...	...
	Pennsylvania	...	×	...
	Reading	...	×	...
	Richmond, Fredericksburg & Potomac	...	×	...
	Wabash	...	...	×

Other administrations understood to possess car retarders :

United States. — Indiana Harbour Belt.
Illinois Central. — New York, New Haven & Hartford.
Boston & Maine. — Texas & Pacific.
Lehigh Valley. — Central of New Jersey

N. B. — (A) Question stated to be under consideration.
(B) Under consideration and estimates being obtained.
(C) Installation at Whitemoor constructed but not yet formally opened.

cularly the Japanese Government Railways, it will be appreciated that it is not possible to allude to all of them individually. Their practices and arrangements are modelled largely on those in force in the countries where railways have, perhaps, been longer in existence, with the principal exception probably that the average wagon or car is of higher capacity than those commonly in use in Great Britain.

Slipper or skate braking.

From the very limited use comparatively of the manually operated slipper or skate in the countries under review, it seems apparent that there is no extensive scope for the development of this form of braking. So far as high capacity cars or wagons are concerned, the braking force is inadequate either as an independent operation or supplemental to hand brakes fixed on wagons or cars.

In those instances where they are used there are generally some special circumstances existing. For instance, at Nuneaton, London Midland & Scottish Railway, the layout is unavoidably such that to enable wagons to run into some of the sidings which are approached by appreciable curves, the hump is of a certain height, and this gives an added impetus to wagons entering other sidings which are more on the straight — thus requiring some means of braking supplementary to hand lever brakes.

Where larger and heavier vehicles are used, as in America, the use of skates as a supplementary or emergency feature in connection with car-retarding or rail braking schemes the skate would appear to serve a useful purpose, but usually where they can be placed on the rail by power operation.

No reports have been received of any arrangement whereby slippers or skates are operated completely by electrical or mechanical process nor, in the countries embraced in this report, are there any known instances of skates being both placed on rail and returned to starting point by mechanical operation such as is understood to be in force at one of the yards in France.

There appears to be an essential difference between the slipper or skate method of braking and the type of rail brake or car retarder as used in America in favour of the latter, as regards capacity for braking wagons, and whereas with the former system the man responsible for operating the skates has to predetermine the length of run he will give the skate, gauged on the nature of the shunt and the speed at which he speculates it is running as it approaches, in the case of the car-retarder or rail brake the brake power can be moderated or increased as the shunt is passing through the apparatus.

Although the cost of installing electrically operated skates is not likely to be so great as in the case of rail brakes or retarders, their effectiveness for dealing with heavy shunts of wagons as compared with rail brake retarders is doubtful.

The use of the slipper as a primary brake cannot be so advantageous. On the other hand there may be instances where the number of wagons to be dealt with is not considerable and the traffic is of a lighter description where electrically operated skates might be considered to meet all reasonable requirements.

Point or switch operation.

The manipulation of points or switches under a concentrated electrically controlled system is a feature which can readily be segregated from the question of rail retarders, skates, etc.

Whilst not at all places is the point and switch operation grouped and operated from one position, there are places apart from America where this is done, as for example, Feltham, Southern Railway of England. There is, one feels, considerable scope for development in this particular sphere, but here again it will probably be found that the all important matter of cost of installation and maintenance enters largely into the question.

At a number of places the operation of points and switches is concentrated, one man in a cabin manipulating levers which effect a purely mechanical procedure by means of point rodding or wires, there being no electrical operation in the process. No comparative data is available to indicate the relative cost of first installation and maintenance of the respective systems. Moreover at many yards in England electricity is not provided, although with the extension of this form of power its use is rapidly being facilitated.

At such yards as Chaddesden, Toton Up (loaded wagon) sidings and Toton Down (empty wagon) sidings on the London Midland & Scottish Railway, at each of which three humps, an average of roughly 4 000 wagons a day are dealt with, the points are not operated from one centre but grouped into sections, a series of pointsmen being employed, and it has not been considered practicable up to the present to alter this method of working. To some extent the lay-out is responsible for this but it is a question whether, with the large number of wagons dealt with daily, the different running speeds attained by different classes of wagon and the existing method of hand braking, it would be feasible to concentrate point operation from one spot.

In order to hump 4 000 wagons a day it means that on an average 166 wagons have to be dealt with every hour, or nearly 3 per minute.

Tests at Chaddesden have revealed that during a net period of actual humping amounting to 18 hours in one day 4 828 wagons were dealt with in 2 939 cuts. From this it will be seen that the average number of wagons per cut amounted to 1.64, and that 2.6 cuts were dealt with per minute on the average throughout the period, there being times of course when the number of cuts on the move in the point or switching area was appreciably greater than 2.6. The time occupied by wagons travelling from the hump to clear of the respective points ranged from 35 seconds to 75 seconds in the case of wagons unchecked by hand brakes, and up to 1 minute 40 seconds where braking had to be applied.

As the points leading to the various sidings are not located at approximately equal radii from the hump, in accordance with more modern practice, the necessity, therefore, for even spacing between the cuts will be apparent.

As a matter, of fact, such type of layout would be difficult if not impossible of actual achievement in the case of some of the older yards, and in some instances could only be accomplished at heavy cost and/or at the expense of sacrificing some of the available siding accommodation, by shortening their length. Such reduction the British railways, at all events, could ill afford. Where there are large tracts of open country this difficulty is not necessarily insurmountable.

In such circumstances, therefore, it may well be that the present method of having a series of pointsmen may be the more economical and that to concentrate the whole at one spot would result in a decreased speed of humping and a fall in the total number of wagons dealt with by reason of the fact that one pointsman

could not satisfactorily watch the progress of one cut until clear of the last points and at the same time deal with cuts following in rapid succession.

The logical conclusion would appear to be to modernize the lay-out particularly of the point or switching areas, and instal electrically controlled rail brakes and points, these operations being concentrated in one cabin or tower.

Even with the most scientifically designed and up-to-date apparatus it is to our mind a question as to whether it would be feasible to deal with more than say, 4 500 wagons a day on the average over one hump, which the London Midland & Scottish Railway is doing today without either car retarders or electrically operated points. The traffic operating density in many parts of Great Britain is very heavy, and on certain sections of line, particularly in the vicinity of our hump yards, it would be almost impossible to accommodate more trains even if the capacity of one hump yard could be materially increased.

General.

Subject to confirmation of the favourable impression gained from the comparatively little knowledge and experience yet available, and provided other considerations are equal, there seems to be no doubt that modern car-retarding methods combined with concentrated electrically controlled switch manipulation are much to be preferred to the older methods of hand braking and manual point operation at hump or gravitation yards by reason of the larger margin of safety they provide in respect of both men and material, apart from any economies rendered possible.

From the point of view of rendering a comprehensive report on the subject under consideration it is perhaps a little unfortunate that the administrations in the country which has done a great deal of late to develop mechanically operated gravity shunting yards, *i. e.* the U. S. A. only two possessing car retarders have replied to the questionnaire. Others, members of the International Association, are known to possess retarder methods, and moreover, certain administrations in the U. S. A. who are apparently not members of the International Association, also own retarding appliances. As, however, many of the installations have only recently been brought into use, it has not been considered advisable to ask them for detailed information, as no useful comparison could be made.

In the circumstances it will be appreciated that it is difficult for instance to arrive at a proper conclusion or express a useful opinion as to whether the all-electric or the electro-pneumatic design is preferable or the more economical. As the car-retarder is a comparatively recent innovation and still in the process of development, it is perhaps not desirable, even if practicable, to offer anything in the nature of a definite pronouncement on this aspect of the subject.

By the time the next Congress takes place in 1933 a sufficient period will have elapsed and considerable further experience will have been gained so that reasoned comparisons can better be made. It is recommended, therefore, that the subject be again included on the Agenda for that Congress and that, as the American rail transportation problem and marshalling yard operations are so different from European conditions, an American reporter be asked to deal with the question on behalf of North America.

In the preparation of this report, it has been necessary to solicit information from

various sources, other than railway administrations, and I would particularly express my thanks to Mr. C. E. R. Sherrington, M. C., M. A., A. M. Inst. T., of the Railway Research Service, London School of Economics, for placing at my disposal his personal knowledge and experience of American methods, also to Mr. J. H. Kay, Editor of the *Railway Gazette* (England), for permission to make use of information on the subject published in that journal from time to time, and to the *Railway Age* (America) for various references and illustrations.

SUMMARY OF CONCLUSIONS.

1. In countries where wagons for the conveyance of goods and mineral traffic are generally of comparatively small dimensions and weight, it is desirable that all should be fitted with hand brakes operated by a lever fixed to the wagon side and manipulated from ground level.

2. In countries where the vehicles are generally of high capacity and comparatively heavy, more adequate means of controlling the speed when not attached to an engine are necessary and up to the present, braking apparatus controlled by a hand wheel necessitating the brakesman riding on the car appears to be essential for use when car retarders are not employed.

3. Where hand braking methods are employed the brakes should, as far as is compatible with the size and weight of the wagon or car be of uniform design and capacity, with the lever or wheel in a standard position. This applies not only within an administration but where rolling stock is, or is likely to be, interchanged between administrations, whether nationally or internationally.

4. Consideration should be given, in the case of all hump shunting yards whether existing or contemplated, where the number of wagons or cars dealt with on an average is considerable, to the question of introducing modern car retarder or rail braking methods, in order to decide whether savings in personal or increased efficiency in working justify the cost of introducing such methods.

5. Electrically or electro-pneumatically operated rail braking or car-retarder methods at the larger gravity or hump shunting yards appear desirable where the rolling stock generally is of high capacity as in the United States.

6. In the countries covered by this report, where the rolling stock is of comparatively small capacity as in Great Britain, sufficient experience of car-retarders or rail brakes has not, up to the time of writing, been gained in order to form a pronounced opinion as to the desirability or otherwise of introduction.

7. Where car-riders have hitherto had to be employed as in the U. S. A., very appreciable savings have been effected by their elimination at the large yards where car-retarders have been introduced.

8. Where brakesmen or wagon steadiers are employed, as in Great Britain, some saving in their elimination should be possible by introducing car-retarders, but not to anything like the same extent as if car-riders were employed.

9. Provided there is no increase in the cost of working and no diminution in the number of cars or wagons dealt with under conditions hitherto existing, also that there is a probability of the outlay being recouped within a reasonable period, car-retarder methods appear to be desirable at the larger yards for the following additional reasons :

a) Less damage to goods and rolling stock;

b) Increased safety of employees;

c) Counteracts slow working due to weather conditions adversely affecting the movement of the ground staff;

d) Enables daily yard capacity to be increased in some instances.

10. Where the amount of traffic normally dealt with is sufficient to justify the cost of installation, car-retarding or rail-braking methods appear preferable to any form of slipper, or skate braking, whether operated by power or manually, by reason of the much greater degree of brake power which can be applied.

11. Power operated skates may be found to be desirable in some but not all instances as a supplementary or emergency measure where high capacity cars or wagons are in general use, depending to some extent on the number of retarders fixed in series.

12. Manually operated skates or slippers are only advantageous in certain conditions, *i. e.* where wagons or cars are not fitted with handbrake, or when necessary to supplement hand braking, or where there is a considerable variation in length of run through point or switching area in one portion of a hump yard as compared with another portion.

13. A switching out or cutting out arrangement in the rails for use in connection with manually operated skates or slippers is desirable.

14. Electrical or electro-pneumatic centralized point or switch operation is desirable at retarder yards, and the control should be located at the same point as the rail brake or car-retarder control apparatus.

15. Centralized control of points or switches at other than car-retarder yards is desirable in principle, although exception may have to be made where the layout of the point or switching areas is scattered.

16. All new hump yards and hump yards converted for car-retarder methods should wherever practicable have the layout on the balloon principle with the points or switches at equal radii from the hump as far as possible.

17. The making out of switching lists or cut cards is a necessary adjunct to successful car-retarding working, and therefore a sufficient number of arrival or reception sidings is essential so that the process of humping can proceed without interruption, *i. e.* while one train is being humped the making out of switching lists for another train on the arrival lines can be proceeded with.

18. Flood lighting of modern type is desirable for all large marshalling yards and particularly for car-retarder yards.

19. Colour light signalling in suitable code is advantageous for controlling speed of hump operations, being duplicated as necessary and supplemented by oral code signals if required.

20. Pneumatic tubes for the transmission of documents afford a desirable means of expediting the conveyance of train documents to the yard office on arrival of trains on the reception tracks, and for other similar purposes.

21. Electric teletype machines afford a ready and expeditious means of transmitting at one operation the switching lists and instructions to the rail brake and switch operators' tower and other parts of the yard as necessary.

22. Loud speaker telephones for verbal messages are of considerable benefit for rapid communication between certain key positions in a hump yard.

[656 .1 & 656 2]

REPORT No. 1

(America, China and Japan.)

ON THE QUESTION OF COMPETITION OF ROAD TRANSPORT (SUBJECT XIII FOR DISCUSSION AT THE ELEVENTH SESSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION), (1)

By C. B. SUDBOROUGH,

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The complex structure of modern life in all the progressive nations of the world owes its existence, as well as all hope for further refinement, more, perhaps, to adequate national systems of transportation than to any other one factor. The relationship between the welfare of any nation and the status of its transportation system is direct and vital; national welfare invariably rises as the national transportation system is improved.

Adequate transportation does not mean the same thing in all countries, because the peculiar needs of each nation must govern the extent and character of its facilities; but it is true, in general, that the larger the country the more urgent is its need for diversified mobility.

No nation of modern times has ever had greater need for mobility than the United States of America. And certainly no other nation has acquired mobility to a higher degree.

Mobility has for a hundred years meant primarily rail transportation in both Europe and America, but the advent of the steam railroad was of vastly more importance to the United States than to the European nations. The railroads literally made the United States, whereas Europe, with its territory already fully settled and national boundaries well established, merely took up the railroad in its stride. The coming of the railroad has, of course, enriched European life to an incalculable degree, but Europe, using only highway and water transportation through many centuries, had already attained full stature.

On the contrary, the railroad arrived early in the national life of the United States, and subjugation of a mighty wilderness, following the ever advancing rails, was virtually accomplished within sixty years. Without the railroad this task undoubtedly would have required centuries. More than 220 years intervened between the settlement of Jamestown and construction of the pioneer American railroads, and in that time the frontier had scarcely been pushed westward beyond the Allegheny Mountains. In 1830, only 23 miles of line were in actual operation. Forty years later the first transcontinental rail line was completed and in twenty years more the national frontier had definitely been crowded into the Pacific Ocean.

After ten years of development on the

(1) This question runs as follows: « Effect of road competition on goods and passenger traffic and the best methods of meeting such competition, both as regards the main lines and the branches ».

Atlantic seaboard, the railroads conquered the Allegheny Mountains in their second decade, reached the Mississippi River by 1860 and arrived on the Pacific Coast in 1869. The next two decades were remarkable periods of railway construction. The total miles of line in the United States in 1870 was 52 922; by 1880 this figure had risen to 93 671 miles, and Montana was the only state in the Union with fewer than 100 miles of line.

It is scarcely conceivable that 65 600 additionnal miles of line were constructed between 1880 and 1890, bringing the total for the nation up to 159 271 miles. In this decade, 70 % as many miles of rail line had been built as had been constructed in the previous fifty years. In a general way, this marked the close of that period in which railroad building anticipated population. Since then new construction has been virtually restricted to the more intensive development of certain areas already fairly well supplied with rail service. This accounts for the amazing rail mileage in the United States today — a grand total of 259 639 miles of line.

This brief historical background is intended to emphasize properly the fact that the steel rail supplied the royal road to political unity, prosperity, and world power for the United States.

Indian travaux and canoes, ox carts, pack horses, Conestoga wagons, stage coaches and canal barges — such was the cycle of transportation in America before the railroad came about 1830. The achievement of the pioneer railroads was to facilitate the colonization of a vast domain. The contribution of that remarkable era of railroad expansion, which set in immediately after the completion of the first transcontinental line, was the transformation of a vast territory of magnificent distances and isolated communities into a compact homeland of a unified citizenship.

The picture today is a national domain of 2 973 774 square miles of land, with great diversity of climatic and topographical conditions and differing economic interest, distributed among forty-eight States, each sovereign in its own sphere. No other single instrumentality has contributed so much to the creation, stimulation and preservation of the economic, social and political unity of the Republic as has steam railroad transportation.

Furthermore, steam railroads still constitute the backbone of the American transportation system, and will, as far as can be foreseen at present, continue indefinitely to grow in importance and in the volume of service required of them by the public. This assertion is made with full appreciation of the tremendous importance of the motor vehicle as a medium of transportation.

The rise of the motor car has been one of the most spectacular and significant developments of the present century. In the last twenty-five years, it has become an integral part of the world's civilization and in this process of absorption the motor car has, in turn, affected our civilization profoundly.

In the United States, the motor car has added to our national life and resources mobility of a new type and in a degree which no other nation possesses. The truth of that assertion rests on the fact that the United States is first among the nations of the world in the production and use of motor vehicles.

The invention of the internal combustion engine brought forth the motor vehicle, and the first patent for an internal combustion engine for the propulsion

of a vehicle was granted in the United States in 1895. In that year four passenger cars were produced in the United States. Ten years later the annual production was 24 550 passenger cars and 450 trucks. Thereafter, the output increased by leaps and bounds until in 1920 it was 1 900 000 cars and 321 789 trucks.

At the close of 1927, the total number of motor vehicles in use in the United States was 23 127 315. These figures represent about 80 % of the total number of automobiles in the world.

The American experience thus far indicates that the real importance of the motor car is in the shorter rather than the longer distances. The first mission of the railroads was to break down the frontiers that separated the early settled eastern seaboard from the interior and the far west. The first mission of the motor car has been to break down social frontiers, existing within much smaller areas, which had survived until very recent years.

In supplying a transportation agency of the greatest flexibility, and making possible the establishment of communication through districts and over routes where the traffic would not justify the construction and operation of railroad facilities, the motor vehicle has undoubtedly made its most outstanding contribution to the economic development of the United States.

In discussing those forms of motor service which are rendered in direct competition with already established and properly functioning railroad facilities, however, we have a very different situation. To say that none of the competitive service justifies itself on sound economic grounds would be too sweeping a statement. On the other hand, to accept it all unreservedly as wise, fair, and in the public interest, would be equally unwarranted.

It is impossible to determine exactly the extent to which American railroads have lost traffic to motor cars. The loss, however, is admittedly large, and beyond that statement two generalizations can be made with safety.

1. The railroad revenues from passenger traffic have been shrinking in the last eight years and a definite relationship is discernible between this decrease and the increase in the number of privately owned automobiles and passenger buses operated for hire.

2. A large volume of freight traffic, which formerly was handled by rail and still could be so handled, is now being transported over the public highways by motor trucks.

The adverse effects on passenger revenues will be considered first as the losses in this branch of traffic have undoubtedly been more serious than in freight.

There is in the United States one passenger automobile in operation for every five persons. This amazingly wide distribution is steadily increasing. The saturation point has not yet been reached, and the production and sale of automobiles is continuing to grow at a rate faster than the growth in population.

Under such conditions a large proportion — probably a very considerable majority — of our families who are in a position to make a journey at all can make it by automobile if they so desire. In fact, many families when planning short trips have got almost completely out of the habit of thinking of train service. Furthermore, long-distance touring, especially for sightseeing and recreation, and often including camping out on the way, has become a nation-wide pastime.

While these factors have undoubtedly created a large amount of new travel activities, *i.e.*, have resulted in people taking trips which otherwise they would not have taken, it is also true that many of these motor-car journeys are indulged in by people who, if automobiles were not so conveniently at hand and the system of improved highways less far flung, would use the trains in many, if not most, instances.

In fact, while definite statistics are lacking, it is quite generally believed by railroad traffic officials that the diversion of traffic from the railroads by the privately operated automobile exceeds in extent that lost through the operation of motor vehicles for hire. Nevertheless, these are important factors in the situation and require careful discussion.

The total number of motor buses in the United States was 85 636 in 1928, and more than half of them, or 43 486, were operated as common carriers by others than steam railroads. These buses were operated over 252 327 miles of route and carried 2 193 000 000 passengers.

Although there are several long distance bus routes, ranging from 229 miles up to 1 404 miles, bus travel at present is predominantly local and short haul. The average length of 490 bus routes in New England is about 16 miles. In eight other states there are 705 separate bus routes, the total mileage of which aggregates 18 169 miles. More than 50 % of these routes are less than 20 miles long, nearly 75 % less than 30 miles, and only 11.9 % are more than 50 miles long. Study of the bus operations in these states shows that 41 % of the mileage is directly competitive with rail lines, *i.e.*, parallels rail lines between the termini; 28 % is indirectly competitive and 31 % is wholly non-competitive.

The standard rate for passenger travel on steam railroads throughout the country is 3.6 cents a mile. Bus fares vary in different parts of the country, being influenced by operating conditions and competition of other carriers. In general, bus fares throughout the country approximate or are higher than railroad fares for short hauls, but are considerably lower for long hauls. The bus fare from Chicago to St. Louis is $7 one-way and $13 round trip; the railroad fare between those cities is $10.41 one-way. From Denver to Los Angeles, a distance of 1 404 miles, the bus fare is $25, while the railroad fare lacks only 71 cents of being twice as much. Convenience and service are the determining factors in short-haul bus travel, while the lower fare is the strong appeal in the long-distance travel.

Buses operated as common carriers in intrastate service are under state regulation in 44 of the 48 states of the Union, but the more than 2 500 interstate bus lines are not at present (January 1929) under any sort of regulation.

The Supreme Court has ruled that the various states affected cannot exercise control over interstate bus service, and thus far the Congress has not enacted the necessary legislation to enable the federal government to bring interstate bus service under supervision. This anomalous situation doubtless will be corrected in the near future, as a bill for the regulation of interstate buses is now pending in the Congress.

The effect of the constantly increasing number of privately owned automobiles and of buses operated for hire on the public highways may perhaps best be indicated by observing the movement of

the passenger revenues of Class 1 roads in recent years. During the eight-year period from 1920 to 1927, inclusive, the movement of railroad passenger revenues has been progressively downward. Total passenger revenues of Class I roads amounted to $1 286 613 000 in 1920 as against $974 950 000 in 1927. This loss of passenger revenue, amounting to $311 663 000, represents a decrease of 24.2 %.

During the same eight-year period, the increase in the total registration of motor cars in the United States was 145.9 %.

Consideration of these figures indicates that each increase of 6 % in the total registration of motor cars causes a decrease of 1 % in the total passenger revenues of Class I railroads.

It should also be noted that during the period under consideration the estimated increase in the total population of the United States was more than 6 %. Thus it appears that this serious loss of passenger revenue by the steam railroads is due almost entirely to the constantly increasing travel by automobile on the public highways. The increase in population referred to above, shows that the total number of potential railroad travelers is constantly increasing and the unusually wide distribution of prosperity among our citizens makes it evident that a constantly increasing proportion of our population are becoming able, if they so wish, to make rail journeys in ever increasing numbers.

In addition, it is widely recognized that travel has increased greatly in the last few years. Therefore, about the only explanation of this peculiar situation is that when our new travelers leave home, especially for pleasure and recreation, the majority of them go by private automobile.

Although the loss in passenger revenue has been shared by all railroads, it is the short lines which have suffered most.

The passenger traffic of rail lines of this type naturally is confined almost exclusively to local travel in day coaches, and this is the kind of traffic to which highway competition is dealing heavy blows. The local passenger traffic of trunk line railroads has been diminished, of course, in a similar manner, but the trunk lines also have their long-distance, deluxe passenger service on which to fall back. In this respect, the trunk lines have been fortunate, because their losses of local passenger business have been partly compensated in recent years by an increase in the long-distance, Pullman car traffic.

This situation is demonstrated by the experience of the Pennsylvania Railroad, which operates over its 11 621 miles of rail line the world's largest fleet of limited passenger trains, as well as an immense amount of local passenger service.

In 1927, the passenger revenue of the Pennsylvania Railroad was less than it was in 1920 by more than $13 000 000. This is a decrease of nearly 7 %, in contrast to the decrease of more than 24 % for all the Class I roads of the country. This indicates that about two-thirds of the entire passenger service supplied by the Pennsylvania Railroad has suffered little, if any, from motor competition on the highways. Nevertheless, the Pennsylvania Railroad also supplies the other side of the picture in its most vivid aspect.

The West Jersey and Seashore Railroad which is controlled by the Pennsylvania Railroad through ownership of a majority stock interest and operated as a division of the Pennsylvania Rail-

road, has a little more than 300 miles of lines in southern New-Jersey, extending from Camden, N. J., just across the Delaware River from Philadelphia, to all the important seashore resorts from Atlantic City on the north to Cape May on the South. Both an electric line and a steam line are operated between Camden and Atlantic City, and a convenient ferry service is provided for the transfer of passengers between Philadelphia and Camden.

The Pennsylvania Railroad, in addition, provides direct rail service from all of its three large passenger stations in Philadelphia to Atlantic City and Cape May. These trains cross the Delaware River on a bridge a short distance northeast of Philadelphia and reach the steam line of the West Jersey and Seashore Railroad a few miles southeast of Camden. The rail service between Philadelphia and Camden and the large resorts in south Jersey is thus flexible and convenient, and it also is rapid. In fact, the fastest railroad run in America is over the West Jersey and Seashore Railroad between Camden and Atlantic City. One year-round train in each direction daily runs the 58.4 miles in 58 minutes.

Since the West Jersey and Seashore Railroad was built and developed primarily to serve the seashore resorts, it is obvious that the railroad's chief source of earnings is the passenger train service. This is not the usual case among American railroads, most of which obtain the greater part of their revenues from freight traffic. For example, the freight traffic produced 66.6 % of the Pennsylvania Railroad's total railway operating revenues in 1927, which was a normal performance.

On the other hand, freight traffic produced in 1927 only 43.6 % of the total operating revenue of the West Jersey and Seashore Railroad, leaving it dependent on passenger train service for more than half of its earnings. Before the era of motor competition, the preponderance of passenger earnings was still greater.

Other pertinent considerations are that it is a short line, with all the important points it serves within easy automobile-driving range, and that its territory is also well supplied with modern, hard-surface highways.

In view of this extroardinary combination of circumstances, one quickly realizes that the position of the West Jersey and Seashore Railroad is especially vulnerable to the encroachment of automobile and bus competition. A few statistics quickly reveal the extent of this encroachment by highway travel.

Passenger business on the West Jersey and Seashore Railroad has been declining progressively since 1920, in which year 15 195 454 passengers were carried, the passenger mileage was 411 169 161 miles, the passenger train mileage 3 213 763 and passenger revenues amounted to $8 316 106. Compared with these results, the 1927 figures for the same items show the following decreases: 36.4 % in the total number of passengers carried, 38.4 % in the passenger mileage, 10.5 % in the train mileage and 27.8 % in total passenger revenues.

In connection with this 27.8 % decrease in the West Jersey & Seashore Railroad's passenger revenues, it is interesting to recall that during the same period the total passenger revenues of all Class I roads in the United States, as previously shown, declined only 24.2%.

The sharpest decline in the West Jersey & Seashore Railroad's passenger traffic took place in 1927, when the decrease

of passenger revenue under that of 1926 exceeded $1 138 000. This extraordinary loss was due in a very large measure to the completion in the latter part of 1926 of a highway bridge over the Delaware River between Philadelphia and Camden. This bridge provides a convenient outlet for automobiles and buses from Philadelphia and its large suburban district in Pennsylvania to the main highways leading to all seashore resorts in the southern part of New Jersey. The stimulation to highway travel, due to the opening of this bridge, became fully apparent in 1927, the first entire year in which the bridge was in service.

In turning to the motor truck, one soon finds that not enough trusworthy data have been tabulated in the United States to provide the necessary background for an accurate presentation of the volume of commodity transport on the public highways. Therefore, the effect of highway competition on the freight revenues can be suggested only in general outline.

It is definitely known, however, that the total number of motor trucks in use is rapidly approching 3 000 000. At the close of 1927, the exact number was 2 896 886. Shippers owned 82 % of these trucks and used them to transport their own products. The remaining 18 % was owned by contract carriers and by « for hire » operators. Altough the actual tonnage carried annually by truck is very large, it is, nevertheless, insignificant in comparison with the aggregate freight service performed by the steam railroads.

The freight traffic handled by the railroads in 1925 amounted to 414 billion 139 835 000 ton-miles. The Bureau of Public Roads estimated that in the same year trucks produced over city streets and rural highways a total of 16 355 526 667 ton-miles. Assuming that one-half of this ton-mileage was produced on interurban highways (which is a very generous allowance), it represented only 1.9 % of the ton mileage produced by the railroads in 1925.

The length of the average haul varies, of course, in different parts of the country, but it has been determined that from 60 to 80 % of the tonnage transported by truck moves less than thirty miles.

Although other factors besides length of haul influence the proportions of total tonnage hauled by motor truck and rail lines, respectively, operating in the same territory, there is a tendency for the proportion of motor truck tonnage to decrease with increase in distance. This is indicated by an analysis of the railroad and motor truck tonnage for an average month in 1925 between Columbus, Ohio, and 30 other cities in Ohio located from 7 to 134 highway miles from Columbus. For hauls of less than 20 miles, 84.5 % of the total tonnage was transported by motor truck; between 20 and 39 miles, motor truck tonnage was 54.7 % of the total tonnage; and for hauls of 40 to 59 miles, 60 to 99 miles and 100 miles and over, motor truck tonnage was 32.0, 24.2 and 2.3 % respectively, of the total tonnage. As the percentage of motor truck tonnage decreased with increase in distance both carload and less-than-carload rail tonnage increased. No appreciable amount of less-than-carload rail tonnage was noted under 40 miles. Between 40 and 59 miles, this less-than-carload rail tonnage was 5.6 % of the total tonnage and the percentage increased to 20.3 for distances of 100 miles or more.

In regard to rates for the transportation of goods by motor truck, there is

even less uniformity than there is in the fares charged for the transportation of passengers by motor bus. It is, of course, impossible to make a fair comparison of truck rates with rail rates unless service, time, packing requirements, door-to-door delivery, emergency conditions and other elements are considered.

In Connecticut truck transportation for 20 miles is 3 cents per 100 pounds lower than the rail rate; for 30 miles it approximates the rail rate; for 50 miles it is two cents higher than the rail rate; for 75 miles it is 10 cents higher, and for 100 miles it is 19 cents higher.

Truck rates out of Boston are lower than rail rates up to 50 miles, and are about equal from 50 to 100 miles. At Minneapolis, Minn., truck rates are generally equal to rail rates, plus 5 cents per 100 pounds for store-door delivery. In North Dakota and Colorado, truck rates are generally higher than rail rates.

Our chief concern is, however, with motor vehicle service which competes with rail transportation. In attempting to gauge the extent of this highway competition and to estimate its effect on the railroads, it is, unfortunalety, seldom possible to be specific, because no official national agency yet exists for the collection and tabulation of motor transportation statistics. In view of this, we have thus far confined our efforts to indicating developments and suggesting trends by reference to typical cases in point or to the statistical results of surveys covering limited territorial districts. Therefore, an accurate reply to the question, « What is the present effect of highway motor transport on the traffic of the railroads ? » is clearly impossible.

Although admitting that obstacles and handicaps exist in profusion, it, nevertheless, seems desirable, especially in the interest of completeness, to venture an approximate answer to that question, based on the discussion thus far.

It will be recalled that the passenger revenue of all Class I railroads in 1927 was $311 663 000 less than it was in 1920, this loss being attributed to privately owned automobile and passenger bus competition. Therefore, the railroads' average annual loss during that period was about $40 000 000.

In regard to truck competition, it is necessary to return to the estimate which rated the total ton-mileage produced by trucks on rural highways as representing nearly 2 % of the total ton-mileage of the Class I railroads, whose total freight revenues in 1927 exceeded 4 1/2 billion dollars. Basing the computation on these figures, it appears that motor trucks annually take more than $92 millions of freight revenues away from the railroads. (This sum may be regarded as conservative, because the Pennsylvania Railroad has estimated its own annual loss due to truck competition as $26 000 000).

In this manner, we arrive at the conclusion that motor vehicle competition annually takes about 130 millions of operating revenues away from the railroads.

The mere magnitude of this loss of revenue is quite enough to cause superficial observers to jump to the unwarranted conclusion that the automobile has placed the American railroads in a very difficult position. They forget that the automobile brings new traffic to the railroads, as well as takes established traffic.

The 1925 census of manufactures revealed motor vehicles as the first industry in the United States. In that year

the wholesale value of its products was in excess of \$3 371 000 000. In 1927, the railroads handled 757 388 carloads of automobiles, trucks and parts, constituting the third largest railroad shipment of manufactured products.

The great importance of automotive freight to the railroads is further emphasized by the fact that 3 267 388 carloads definitely traceable to the manufacture and use of automobiles were moved by the railroads in the same year.

In recent years, while passenger traffic has been declining, the steam carriers have been called on to move a constantly expanding volume of freight traffic, and the remarkable growth of the automobile industry has been one of the principal factors contributing to this steady increase. The motor industry thus turns out to be one of rail transportation's best friends, in that it is constantly creating new business which, in the opinion of many of the ablest authorities, more than repays the railroads for what it appropriates to itself.

Now, having examined the various aspects of the relationships between the railroads and motor transport,we appear warranted in the conclusion, taking the broadest possible view of the question, that the railroads are really the gainers from the establishment and growth of the motor industry. Furthermore, the present balance in their favor appears destined to grow steadily with the wider recognition which is now being accorded to the innately harmonious and supplementary character of the transportation service rendered by these two agencies. Coordination between rail and bus service, with elimination of wasteful competition, which in the past has been harmful to both, is now well under way and is one of the most promising fields of transportation progress in this country.

The general policy of the railroads at present may be summarized briefly by saying that they are now embarking on a comprehensive campaign to tie in motor transport with their own train operations. This movement is based on the accumulated experience of 25 years with the motor car, and the salient feature of that experience is that the economic use of motor vehicles as commercial carriers is virtually limited to the performance of local transportation service, because their carrying capacity is small. It was brought out earlier in this report that the average bus route is between 20 and 30 miles, and that the bulk of the truck tonnage movement is confined to the distribution of goods within cities and short-haul areas. In other words, motor vehicles are peculiarly adapted to the « retail » forms of transportation service, in contrast with the « wholesale » forms for which the railroads are so eminently suited.

In attempting to outline how the American railroads are working toward coordination of rail and motor vehicle service, we shall discuss the program of the Pennsylvania Railroad, with which we are most familiar. In addition, the Pennsylvania Railroad is thoroughly typical of the railroads in the United States, and no other Company is more active in this particular field.

The Pennsylvania Railroad announced, in January 1928, that, as a result of several years' careful study, plans had been worked out and adopted for the complete coordination of rail and bus passenger service in the territory served by its lines. This coordinated service is being established progressively wherever need exists, either in the public in-

terest or to encourage the development of the Company's general passenger traffic.

When this broad program has been completed, passengers over specified routes will have the option of making their journeys partly by rail and partly by bus, using sleeping cars at night and buses for all or part of the daylight hours of the trip.

Other features contemplate the sale, over certain routes,, of through tickets covering joint rail and bus journeys; the operation of buses to perform the functions of local train service over selected stretches of main or important rail lines, where this is advisable in order to speed up the operation of through trains; also the use of buses, where conditions warrant, to take the place entirely of passenger train service on branch lines of light traffic.

In addition, it is intended to utilize bus lines more effectively than heretofore as feeders for the rail service, and also to extend or improve bus transportation service in territory not conveniently served by existing railroad facilities.

The carrying out of the general plan involves, in some cases, the establishment of new bus lines and in other instances negociation of working arrangements with lines already existing, as well as the acquisition of a financial interest in them.

In lending its endorsement and support to passenger bus service on the public highways in this manner, and tying in such service with its own train operations, it is the policy of the Pennsylvania Railroad Management to assure the public that all bus operations with which it is associated shall be conducted upon the same standards of dependability and quality as are identified with its train service. In this manner the Pennsylvania Railroad believes that the public will be able to enjoy a much higher and more reliable form of passenger bus service than has heretofore been possible.

The Pennsylvania Railroad's program of motor service is being chiefly developed through a subsidiary corporation known as the Pennsylvania General Transit Company, chartered in the State of Pennsylvania but also legally empowered, under certain conditions which cannot here be dealt with in detail, to render public service in other States of the Union as well.

Even prior to the incorporation of the Pennsylvania General Transit Company, the Pennsylvania Railroad had been a pioneer in adapting motor vehicles to railroad use. Up to that time, however, this work had been confined to employing trucks, operated by independent trucking companies under contract, to perform the work of package or way freight trains in light traffic territory, and also to effect the interchange of freight between stations in terminal districts.

In utilizing trucks for the way freight service, the vehicles employed merely go from station to station, picking up and putting down the packages on the station platforms. As far as patrons are concerned, they render exactly the same service as the freight trains they replace. They merely run upon the adjacent highways instead of the railroad tracks.

Up to 31 January 1929, the Pennsylvania Railroad had motorized 3 384 miles of freight line, thus serving 697 stations. Sixty-four trucks, eleven trailers and two tractors were used in this service.

The use of trucks in terminal work is also rapidly progressing in the Cincinnati Terminal district, and between St. Louis and East St. Louis the Pennsylvania Railroad participates with all other roads entering the district in effecting the inter-station and inter-line transfer of all freight under trucking contracts. Similar arrangements are also in operation, but confined to interchange among Pennsylvania Railroad stations only, at New-York, Philadelphia, Detroit, Toledo, and Baltimore, where 13 tractors, 6 trucks and 39 trailers are in use.

In this terminal district inter-station work, including participation with other lines, a total of 103 tractors, 309 semi-trailers, 15 chasses and 220 demountable bodies are devoted exclusively to railroad use. In addition, a large volume of freight is inter-changed by truck under contracts based on weight hauled and not calling for exclusive use of the vehicle.

The use of motor trucks in coordination with railroads unquestionably reaches its highest economic development in collection and distribution within terminal zones, thus making possible a complete through transportation service from the door of the shipper to the door of the consignee.

Complete integration of motor truck and railroad facilities is thus provided in the so-called container car service now offered over certain routes by the Pennsylvania Railroad, as well as two or three other American railroads.

This new form of service for less-than-car-load freight is based upon the use of portable steel containers so constructed that they may be carried either upon especially equipped railroad cars or upon motor trucks. This feature of interchangeability permits of ideal coordination, and the system also enables shippers and consignees who so desire to be relieved of handling their goods between railroad terminals and their places of business.

In this form of coordinated service the motor trucks do their work entirely within the terminal zone. Their function is to act as collectors and distributors of freight between the railroad station and the business places of patrons. The rail lines are used for the long inter-city hauls, which the railroads are able to perform with greater efficiency, dependability and economy than trucks operating upon the highways.

Patrons using the new service may, if they wish, avail themselves of the services of a trucking company, which operates in all the cities where container car service is offered. This organization collects shipments at the vatious points of origin by making day to day calls with containers carried upon motor trucks. When the containers are loaded, they are placed by cranes upon flat cars awaiting them at designated stations, and then are moved through to destination on scheduled trains with other freight.

Upon the termination of a run, the trucking company, for consignees who so desire, takes possession of and delivers the freight to the consignee's door.

These supplementary services however, are entirely optional with both shippers and consignees, who are perfectly free to make their own trucking arrangements whenever that is preferable.

The rates between rail terminals for the container car service are on a scale somewhat lower than those applying to less-than-carload shipments transported in the ordinary method. This is by reason of the fact that the railroad com-

pany is free from duties and responsibilities of loading and unloading, and that heavier, and, therefore, more economically transported ladings per car are anticipated.

The demand for container car service has grown rapidly since it was introduced on the Pennsylvania Railroad in 1928, and new routes are constantly being added.

Such, then, is the answer of the Pennsylvania Railroad in particular and the American railroads in general to the question, « How can highway competition be met most effectively »? It means that railroads can no longer confine themselves to rail transportation, but must also enter the general business of transportation by motor bus and motor truck. This position is based on the certainty that our country's continued development will require low-cost transportation in ever increasing volume, and on the realization that the demands of the future can be met only by a thoroughly coordinated national system of transportation, in which the railroad, the automobile and the airplane, each functioning with maximum efficiency in its most useful field, supports and supplements one another.

[626 .1 (.44 + .45)]

The Franco-Italian Railway from Nice to Coni via Sospel,

By G. BLOT,

ENGINEER OF THE PARIS-LYONS AND MEDITERRANEAN RAILWAY.

Figs. 1 to 36, pp. 780 to 806

(*Le Génie Civil.*)

HISTORICAL. — It will be remembered that Mr. Tardieu, Minister of Public Works, accompanied by Mr. Gabriel Cordier, President of the Board of the Paris, Lyons and Mediterranean Railway Company, Mr. Margot, General Manager, and the head officers of the Company, opened on the 30 October 1928, the international Nice-Coni line which brings Nice into direct communication with Turin as will be seen by reference to the map (fig. 3.)

On account of its situation, as well as of the economic importance of the line, and its international character, everything possible was done to make the ceremony really brilliant, and to make it the occasion of a manifestation of Franco-Italian friendship. The French minister met his Italian confrère at the International station at Breil, where a banquet to which many leading Italians were invited, was given.

The line was opened to service the following day, that is to say, on the 31 October 1928.

This mountain line, of the greatest interest for tourists, will contribute very effectively to the development of transit and exchange traffic between the south-east of France and the north of Italy. Its construction is the result of long negociations between France and Italy, which we will mention briefly before describing the very interesting works that had to be carried out.

Between 1882 and 1900, the Italians built a line connecting Coni with the Col de Tende (fig. 2) and wanted to extend it as far as Vintimille following the natural location along the Roya valley; but this solution involved crossing 18 km. (11.2 miles) of French territory through the three communes of Fontan, Saorge, and Breil.

An international convention dated the 6 June 1904, was drawn up between the French and Italian Governments for the establishment of direct railway relations between Nice and Coni on the one part, and between Coni and Vintimille on the other.

This convention, ratified in France by the law dated the 20 March 1906, stipulated that France would build on its territory, a line connecting Nice to the Italian System near Coni, via Sospel, as well as the beginning of the branch line leaving at Breil the main line, and running down the Roya valley towards Vintimille.

The convention also specified the conditions with which the location of the line between Sospel and the frontier should comply, that is to say, to pass from the Bévera valley to the Roya valley by a tunnel under Mont Grazian.

Furthermore, the law of the 16 March 1906 conceded the parts of the line situated in France to the Paris, Lyons and Mediterranean Company.

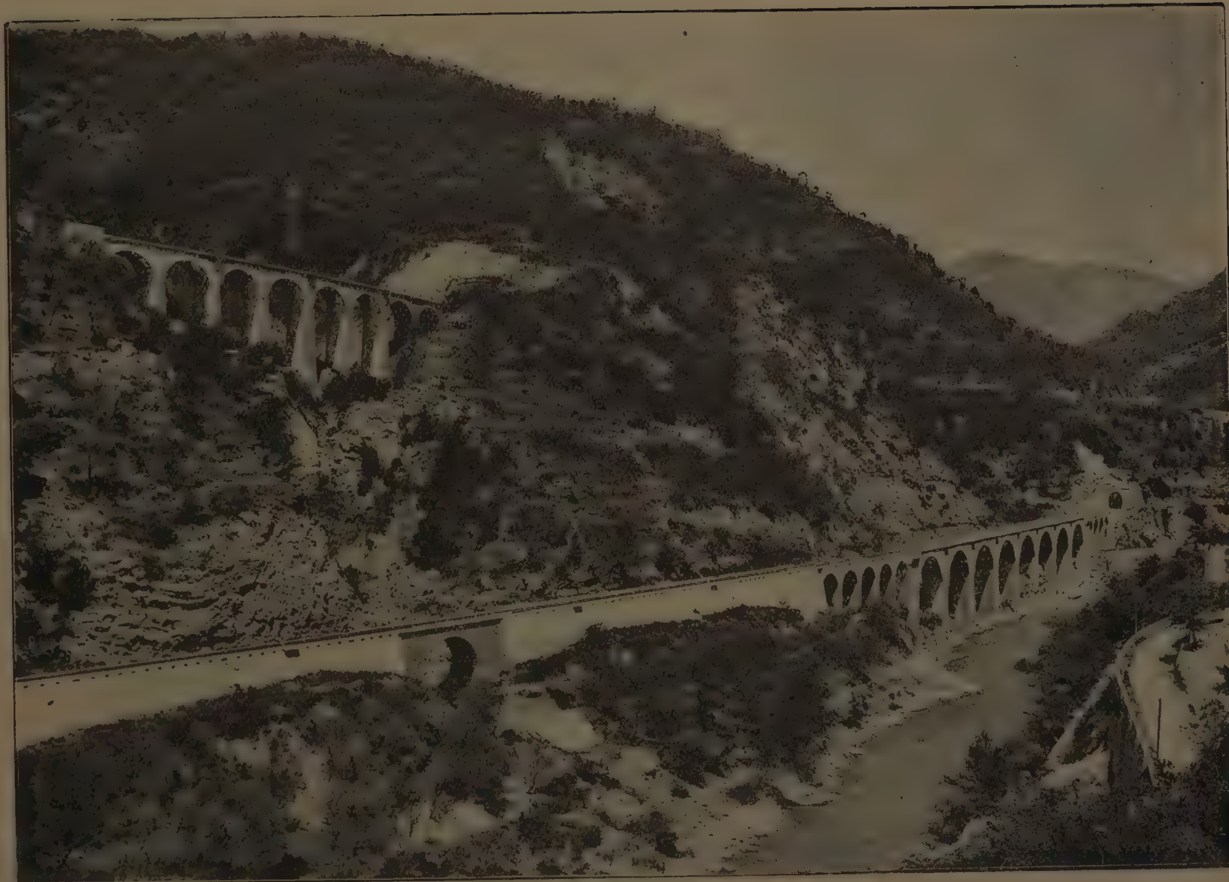


Fig. 1. — The Franco-Italian railway from Nice to Coni. Above, view of the main line with the Bancao viaduct and below, the Vintimille branch with the Eboulis viaduct on the right hand bank of the Roya.

Particulars of the line and of the method of operating it. — The total length of the line in France is 63.164 km. (39.25 miles) 58.767 km. (36.52 miles) on the line from Nice to the North Italian frontier, and 4.397 km. (2.73 miles) on the branch from Breil towards Vintimille that is towards the southern frontier.

The line is single track (only the long tunnels have been built for two tracks in order to ensure proper ventilation).

The steepest gradients are 1 in 40 and the minimum radius of the curves 300 m. (15 chains).

As figure 2 shows, there are several main stations: Nice-Saint-Roch, Drap-Cantaron, Peille, l'Escarène, Sospel, Breil, Fontan-Saorge, and three wayside stations: la Trinité-Victor, Peillon-Sainte-Thècle, and Touët-de-l'Escarène.

The two latter only deal with passenger traffic.

The French trains coming from Nice stop at Breil, where the vehicles are attached to the Italian trains from Vintimille, and continue forward to Coni.

Location. — The line (figs. 2 and 4) starts at the centre line of the passenger station building at Nice at 15 m. (49 ft. 2 1/2 in.) above sea level. It runs through the Carabacel tunnel, turns northwards, crosses the Paillon, serves the Nice-Saint-Roch station, follows the Paillon valley to La Trinité-Victor, crosses the Paillon twice, serves the Drap, Peille, and Escarène stations, runs under the Col de Braus through the longest tunnel (5 939 m. = 6 495 yards) on the line, serves Sospel station, crosses the Bévéra by a steel bridge of 90 m. (295 ft. 3 3/8 in.) span supported at the centre by an ogival arch in masonry, and passes from the Bévéra valley to the Roya valley by the Mont Grazian tunnel (3 887 m. = 4 251 yards), 2 305 m. (2 521 yards) of which is through Italian territory. On leaving this tunnel, at Breil, it connects with the Vintimille branch at 305 m. (1 000 feet) level, runs into the Roya valley crossing the deep gorge of the river twice, first on the Saorge masonry bridge, 60 m. (196 ft. 10 1/4 in.) above the river, and then at 42 m. (132 ft. 9 1/2 in.) above it on the Scarassoui bridge (fig. 5) [the finest work on the line, with its raised arch of 48 m. (157 ft. 5 3/4 in.) span]; finally, by a loop including the Berghe tunnel (1 885 m. = 2 061 yards in length) it joins up with the Italian line at an altitude of 600 m. (1 969 feet). The branch, of which 4.397 km. (2.73 miles) is on French territory, starts on a line with the passenger buildings in Breil station; it follows, at first parallelly, the Nice line, runs under it, runs down the Roya valley and reaches the southern frontier at 226 m. (741 feet) level.

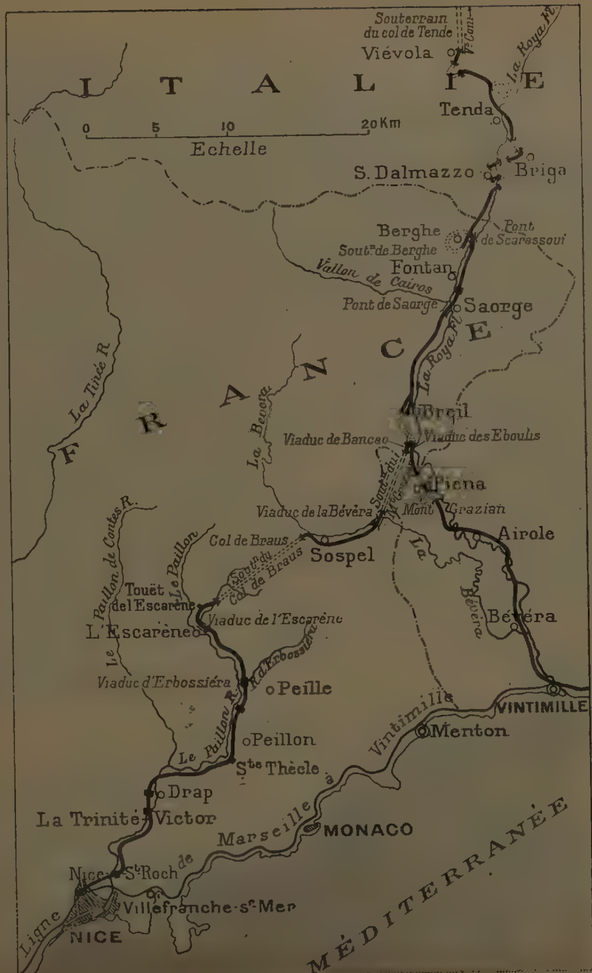
Tunnels. — The line includes many and heavy constructional works which will be considered later on, and 45 tunnels, 41 on the main line having a total length of 23.6 km. (14.7 miles) or more than one third of the total length of the line (see fig. 4).

Four are of great length: on the main line, the Col de Braus tunnel (5 939 m. = 6 495 yards) the longest double track tunnel in France, the Mont Grazian tunnel (3 887 m. = 4 251 yards) and the Berghe tunnel (1 885 m. = 2 061 yards): on the branch, the Gigne tunnel (1 188 m. = 1 299 yards).

The entrances to the tunnels have been treated severely and show a sense of solidity harmonizing with their surroundings.

Equipment of the principal stations. — The Nice Saint-Roch station is laid out to deal with fast and slow goods services, the passenger buildings, for example, being 75 m. (246 feet) long with a building 43 m. (141 feet) long for parcels work attached to it.

The engine depot is also at this place. It has an annular shed in reinforced concrete 110 m. (361 feet) in diameter



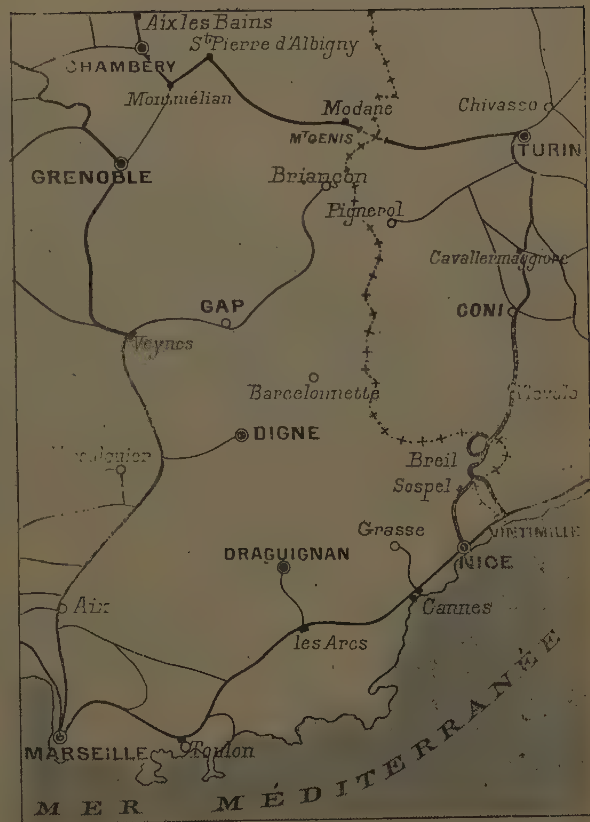


Fig. 3. — Map of the railway communications between the South East of France and Piedmont.

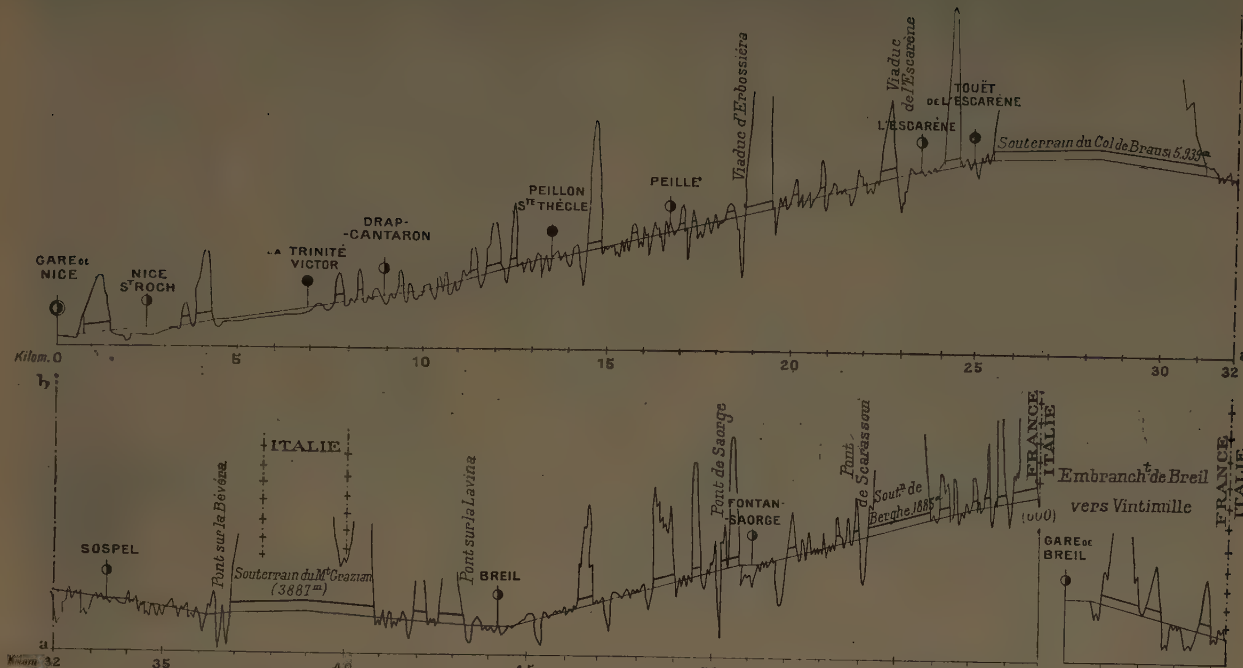


Fig. 4. — Gradient section of the parts of the Nice-Coni line and of the Breil-Vintimille branch in French territory.

Fig. 5. — The Franco-Italian Railway from Nice to Coni. View of the Scarassoui bridge of 48 m. (157 ft. 6 in.) span.

holding 47 engines with a lifting shop also in reinforced concrete equipped to take 6 locomotives.

At the international station of Breil where the French trains stop and through which the Italian trains between Coni and Vintimille pass, are the buildings and platforms required by the two customs services.

The Fontan-Saorge station served by the Italian trains also deals with the two customs services.

Time taken to carry out the work and difficulties encountered. — The work begun in 1909 was completed in 1928 only, but was suspended for five years during the war, and, for some years after, the lack of funds prevented it being pressed more actively.

In addition it is especially necessary to take into account the difficulties of all kinds encountered due to a notable degree to the geological formation of the ground run through which disintegrated on contact with the atmosphere and water, swelling up and crumbling away.

The sulphatic water due to the dissolution of gypsum decomposed the mortar. The beds of lime stone separated by thin layers of clay are in a state of unstable equilibrium and when worked, or under the effect of rain, swell up and move.

Action was taken against the effect of the water by driving drainage galleries and by daming. To avoid decomposition of the mortar through the water containing sulphates, tests of all kinds of cements were made, but in vain: the cement « fondu » alone gave good results. This cement is known to be an aluminate of lime forming a quick hardening cement of great strength, and is obtained by the fusing of a mixture of chalk and bauxide (aluminate and silicate of iron forming the ore of aluminium of which there are large deposits in Provence.)

The most interesting example of the steps taken against the formation of anhydrite is given by the Col de Braus tunnel and we will describe the procedure adopted to evacuate the waters so as to dry out the anhydrite.

Drainage of the Col de Braus tunnel. — The anhydrite is anhydrous sulphate of lime; in contact with water, or moist air, it changes into gypsum, by absorbing two molecules of water when it expands considerably.

Towards 1860 in the Genèvreuille tunnel, between Vesoul and Lure (on the Paris-Mulhouse line), anhydrite was encountered. First of all the water was drained through a gallery driven 8 to 10 m. (26 ft. 3 in. to 32 ft. 9 3/4 in.) below the tunnel and the linings reinforced; the expansion continued and broke up the masonry work. The linings were then pierced by niches, the material behind removed, and the space so made filled with dry stone. The anhydrite in expanding partially filled the spaces between the dry stone; continuing to swell, it forced the filling of dry stone into the niche. When this lining was seen to belly out, the dry stone was demolished, the anhydrite removed, and the dry stone replaced. The drainage gallery had to be kept clear all the time.

In the Col de Braus tunnel, anhydrite was found on a length of 1 000 m. (3 280 feet) on the Coni side (fig. 6). In this part the gallery was driven before the war; the rock was absolutely dry; a lining was used like that of the Genèvreuille tunnel with niches in dry stone. Then war interrupted the work. In order to find work for the unemployed, the work was again taken in hand in 1915; the header was driven forward after passing the anhydrite through jurassic chalk, into limestone fissured with upper cretaceous chalk; much water (222 l. = 49 gallons per second) was encountered.

Now, at that period the Government having decided to devote all the resour-

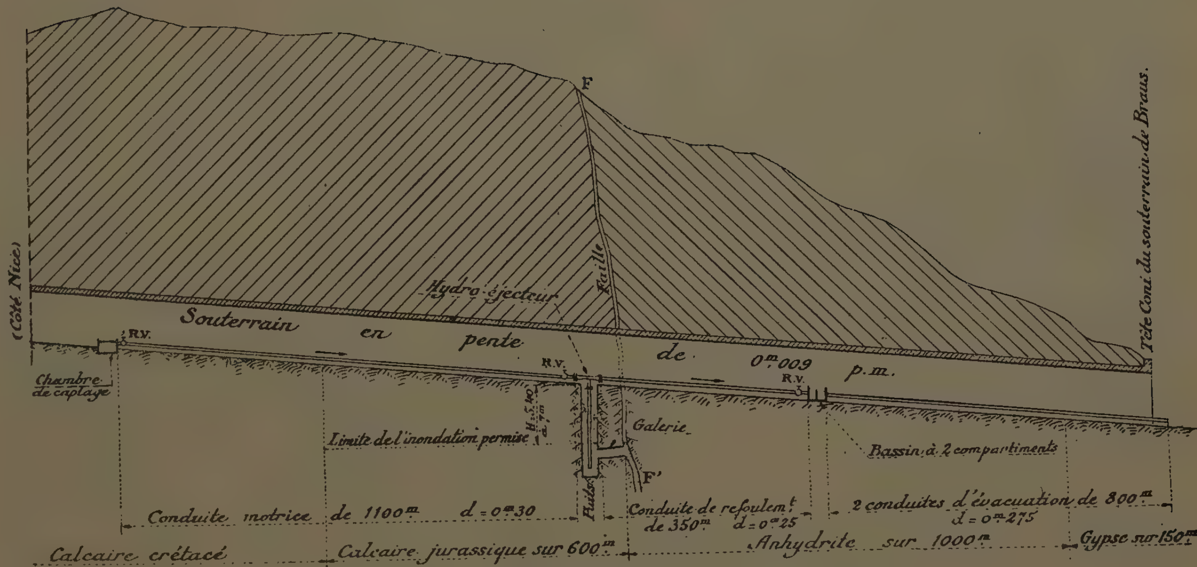


Fig. 6. — Method of draining the Braus tunnel driven through anhydrite.

Explanation of French terms :

Anhydrite sur 1 000 m. = Anhydrite for 3 280 feet. — Bassin à 2 compartiments = 2-compartment reservoir. — Calcaire crétacé. = Cretaceous limestone. — Calcaire jurassique sur 600 m. — Jurassic limestone for 1 969 feet. — Chambre de captage = Collecting chamber. — Conduite motrice de 1 100 m. d. = 0.30 m. = Power main, 3 609 feet, of 11 13/16 inches diameter. — Conduite de refoulement de 350 m. d. = 0.25 m. = Discharge main 1 148 feet long, diameter = 9 7/8 inches. — 2 conduites d'évacuation de 300 m. d. = 0 275 m. = 2 drainage mains, 984 feet long, diameter = 10 13/16 inches. — Côté Nice = Nice end. — Faille = Fault. — Galerie = Heading. — Gypse sur 150 m. = Gypsum for 492 feet — Hydro-ejecteur — Hydro-ejector. — R. V. = Gate valves. — Souterrain en pente de 0m (09 p. m. = Tunnel on a gradient of 1 in 111. — Limite de l'inondation permise = Maximum flood depth allowed. — Tête Coni du souterrain de Braus = Coni end of the Braus tunnel.

ces of the Country to the war, stopped the work. From the end of 1915 to 1919, water ran through the tunnel. It quickly hydrated the anhydrite which expanded; parts of the lining then started to break away.

The anhydrite is slightly soluble in water (2 grammes per litre approximately). In contact with water, the anhydrite in the Braus tunnel openèd like the pages of a book, the water penetrated into it, dissolving the rock and hollowing out channels below the formation.

In 1919 when it was desired to resume operations, in place of the dry and sound anhydrite left in 1914, a rock full of water, swollen and dislocated was found instead. The water difficulty was overcome as best might be and a lining like the Genèvreuille but more robust was provided. Nevertheless, at the end of a year the pillars between the niches broke down and the formation swelled up. When borings were driven into the formation, water was found within a few decimetres. It was this water which, by hydrating the anhydrite, transformed it into gypsum and caused it to expand; the pressure of the ground upwards raised the lining and crushed it against the mountain above.

Where did this water come from? It could not be that from the cretacious chalk 1 500 m. (4 920 feet) farther along which had been properly drained. But where the anhydrite and jurassic chalk met there was a fault FF (fig. 6).

Although it was full of clay it was thought that the water might have introduced itself at this point into the upper layers or at the level of the ground. A pit was sunk 10.50 m. (34 ft. 5 in.) deep in the chalk beyond the fault from which it drained the water.

The yield of the well being on the average 8 l. (2 gallons) a second, it was observed that after pumping a considerable time the quantity of water taken up by the anhydrite diminished so that in fact the water had found its way in at the fault.

First of all it was thought it could be drained through a gallery driven below the tunnel as at Genèvreuille, but in this case it would be very long, and would come out, beyond the tunnel, through very bad clay. How could one build a lining which would resist the thrust of the dislocated and partly hydrated anhydrite?

The idea of doing so was abandoned and an endeavour made to get the water out of the well by some simple device without pump or motor, working automatically so as to avoid any costly supervision. Consideration was first given to the use of a syphon started up by a vacuum ejector and having the flow branch on a slope of 9 mm./m. (1 in 111) discharging at the Coni end of the tunnel, 1 150 m. (3 773 feet) beyond the well.

But the syphoning load being small and the flow branch having a great length and little slope there was doubt as to the syphon functioning with certainty.

The solution adopted consists in the use of a hydro-ejector (fig. 6) fed by a spring situated in the high part of the tunnel which makes it possible to draw the water from the well and to discharge it towards the Coni end by a metal pipe of reduced length which can syphon. The minimum motor discharge available is 20 l. (5.3 gallons) per second under a gross load of 9.70 m. (31 ft. 10 in.) The quantity to be drawn out varies from 5 l. (1.3 gallons) at the summer season, to 9 l. (2.4 gallons) during the period of heavy rain.

The flood level allowable so as to properly protect the anhydrite region is at 7 m. (23 feet) below the formation on a line with the well with an exceptional allowance of 1.60 m. (5 f. 3 in.) above this level during floods and for a very short period.

A scheme for an ejector was prepar-

Fig. 7. — Escarène masonry viaduct consisting of eleven arches, of 15 m. (49 ft. 2 1/2 in.) span.

ed on this data, by the « Société des Appareils à jet »; but, as the working conditions of the equipment were outside the usual limits used, it was decided before making any plant, to carry out some experiments using the largest pattern of ejector manufactured by the Company (with an output of 14 l. = 3.7 gallons per second). The hydro-ejector at Braus consists of a motor converging cone and a diverging mixing cone in bronze fitted into the horizontal branch of the body of the apparatus, the vertical branch of which forms the suction tube. The equipment is placed level with the formation of the tunnel on a reinforced concrete slab over the well.

The main bringing the power water is 0.30 m. (11 13/16 inches) diameter inside and 1 100 m. (3 608 feet) long: it is fed from a spring the water of which is collected in a tank formed in the side wall of the tunnel.

The vertical suction pipe is 0.25 m. (9 7/8 inches) inside diameter, and 10 m. (32 ft. 9 3/4 in.) high; it is fastened against one side of the wall of the well. The discharge pipe carrying away the power water and the suction water is 0.25 m. (9 7/8 inches) in diameter, and 350 m. (1 148 feet) long.

Its outer end discharges into a steel tank having two compartments divided by a weir. This tank also receives the water from the central water channel, which is piped through the anhydrite section in two steel mains of 0.275 m.

(10 13/16 inches) diameter which are carried through to the Coni end of the tunnel.

All the pipes are in solid drawn steel, not welded. The pipes therefore have sufficient spring to be able to adjust themselves to any disturbance of the formation caused by the swelling of the anhydrite. The joints of the pipes are spigotted, and are made with lead and hemp, except in the case of the suction and discharge pipes where they are autogenously welded in order to get perfect tightness.

The plant started up in August 1928 has given very satisfactory results. With a motor output of 20 l. (5.3 gallons) per second and without making use of the forward discharge, the quantities of water drawn up have varied from 8 l. (2 gallons) per second with 9 m. (29 ft. 6 in.) lift, to 12 l. (3.2 gallons) per second with 5.50 m. (18 feet) lift. The water level in the well was lowered to a depth of 9.6 m. (31 ft. 6 in.) in dry weather.

Syphoning is started by removing all air from the discharge pipe, by means of a gate valve and a discharge valve; it creates at the outlet of the ejector a discharge which remains fairly stable for moderate suction lifts and which increases by more than 50 % the quantity drawn up.

This discharge forms a supplement of suction strength, which is not needed under present conditions, but which would be very valuable if the level should rise in the well through unusual quantities of water appearing and exceeding the maximum discharge noted so far. In order to make it easy to examine the hydro-ejector and to renew, when required, the cones, the installation is so arranged that the plant can be taken apart very quickly.

Bridge work. — A mountain railway, such as the Nice-Coni, crossing many valleys and ravines, obviously involves many bridges. This line has more than 200 in steel, reinforced concrete and masonry, 40 of which have spans equal to, or greater than 10 m. (32 ft. 9 3/4 in.) and of a total length of more than 3 km. (1.86 miles).

The principal steel structures are: the Bévéra viaduct (figs. 8 to 11, 24 and 25), a top road bridge in two bays joined together, each of 45.30 m. (148 ft. 7 1/2 in.) span, the middle of the bridge being carried on an ogival masonry arch; then two bridges over the Paillon: the Trinité-Victor bridge, a bottom road bridge in three bays joined together, of 28.70 m. and 31.57 m. (94 ft. 3 in. and 103 ft. 7 in.) span; the Vernes bridge, a top road bridge of four bays rigidly connected together of 26.09 m. and 28.46 m. (88 ft. 7 in. and 93 ft. 4 in.) span.

The following *reinforced concrete* bridges may be mentioned: a road bridge over the Paillon, 61 m. (200 ft. 1 1/2 in.) span, with three continuous bays of 17.37 m. and 26.26 m. (57 ft. and 86 ft. 2 in.) span with curved lower booms. Finally, in *masonry:* 22 viaducts the arches of which have spans varying from 6 to 36 m. (19 ft. 8 1/4 in. to 118 ft. 1 1/4 in.), such as the Erbossiéra viaduct with one 10-m. (32 ft. 9 3/4 in.) arch, nine of 8 m. (26 ft. 3 in.) and an intermediate stilted elliptical arch of 36 m. (118 ft. 1 1/4 in.); the Escarène viaduct (eleven arches of 15 m. (49 ft. 2 1/2 in.); seven single span arch bridges of 14 to 48 m. (45 ft. 11 1/4 in. to 157 ft. 5 3/4 in.) span such as the Saorge bridge (40 m. = 131 ft. 2 3/4 in.) and the Scarassoui (48 m. = 157 ft. 5 3/4 in.).

Amongst these structures, the only ones to be described are: the steel viaduct over the Bévéra, of interest because of its ogival masonry pier, and because of the ingenious arrangements used when getting the bridge into place; the elegant Escarène viaduct (fig. 7): the Eboulis viaduct (fig. 1) designed to give clear-

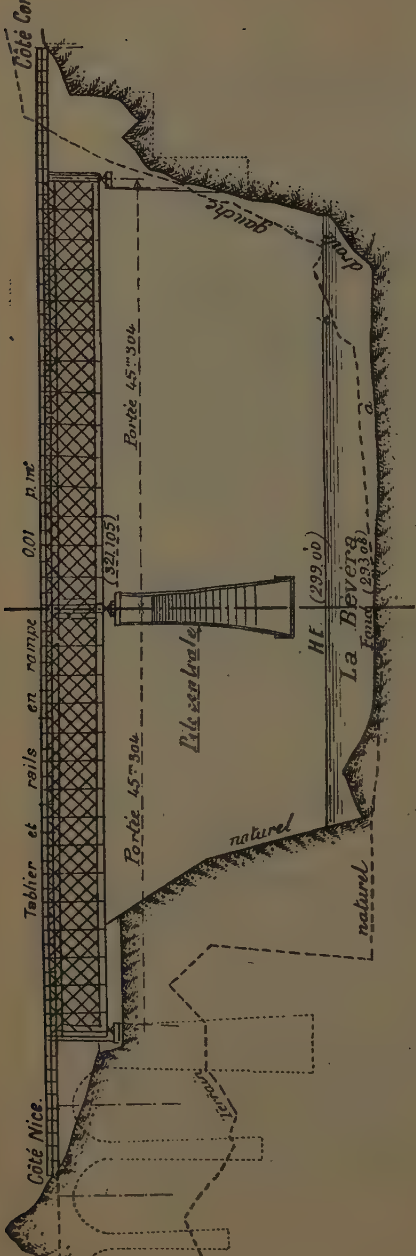


Fig. 8. — Steel bridge over the Bévéra. — Elevation, right hand side.

Explanation of French terms : Côté Coni = Coni end. — Côté Nice = Nice end. — Foncé = Excavated. — Naturel à droite — Natural foundation on the right hand side. — Naturel à gauche = Natural formation on the left hand. — Pile centrale = Centre pier. — Portée de 45.304 m. = Span of 148 ft. 7 1/2. — Tablier et rails en rampe de 0.01 p. m. = Bridge and rails on a rising gradient of 1 in. 100. — Terrain = Ground.

way to any slipping that should occur; the monumental Scarassoui bridge, and the boldly conceived Saorge bridge.

The article will end with some details of the reinforced concrete brackets of exceptionally large size, which support the flank walls of one abutment of the Lavina arch bridge in order to avoid having to build it on extremely deep foundations.

Viaduct over the Bévéra. — The line makes a very acute angle with the Bévéra (fig. 9) which resulted in the structure having a total span of 90 m. (295 ft. 3 in.) between abutments. An intermediate pier had to be provided which, in order not to have to erect it in the river itself, has been built in the form of an ogival arch in masonry transversely to the bridge, of 25 m. (82 ft. 1/4 in.) span and 16.65 m. (54 ft. 7 1/2 in.) rise, taking support on the rock on each bank (figs. 8 to 11 and 25). The steel bridge is carried at its centre by this ogival arch, and thereby consists of two joined up bays 45.30 m. (138 ft. 7 1/2 in.).

Erection. — The details of the bridge were forwarded via Vintimille and Breil and, for erection, the formation of the railway between the abutment of the structure (Coni end) and the beginning of the Basséra viaduct, for a length of 65 m. (213 ft. 3 1/8 in.) was used.

The bridge was worked out until it was above its final position: it is 91.19 m. (299 ft. 2 1/4 in.) long, the length of the leading nose fitted to it to reduce the overhang during this operation being 26.12 m. (85 ft. 8 1/4 in.) : the whole bridge would then have occupied a total length of 117.31 m. (384 ft. 10 1/2 in.), but owing to the ground available being too short the erection was done in sections each of which was run out over the river in turn.

In addition when the masonry work of the abutments was completed the level of the earthwork was 5 m. (16 ft. 5 in.)

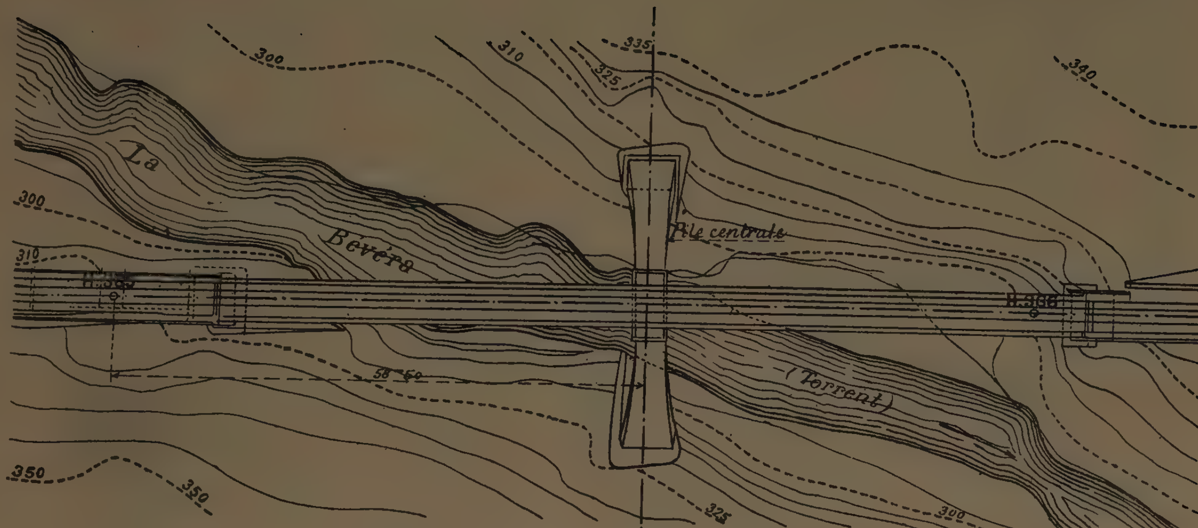


Fig. 9. — Steel bridge over the Bévéra. — General plan.

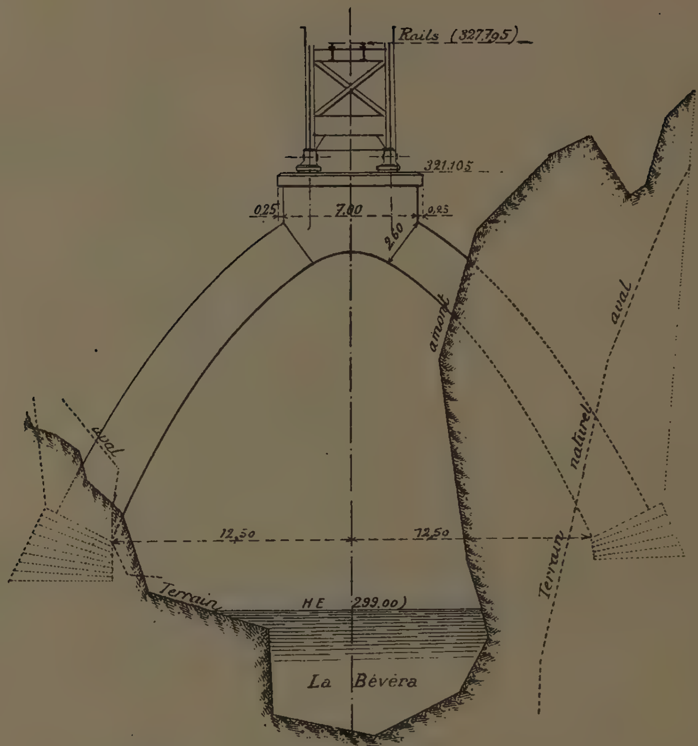


Fig. 10. — Steel bridge over the Bévéra. — Upstream elevation of the central pier.

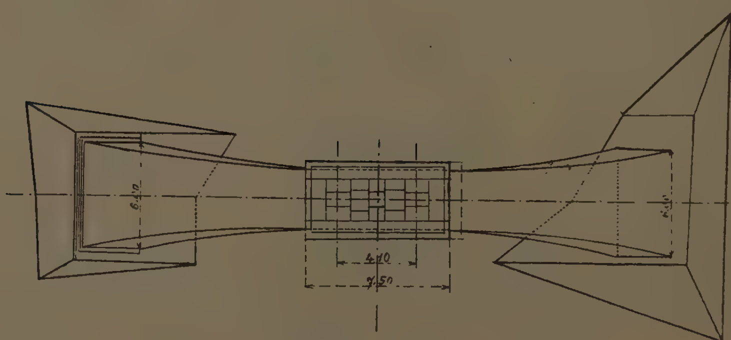


Fig. 11. — Plan.

above that of the bearings as the bridge was of the top road type. Consequently getting the bridge into position involved not only running it out but also subsequently lowering it onto the bearings.

The whole of these operations was carried through with success as a result of the careful arrangements made by « La Construction métallique Haut-Marnaise » Company of St.-Didier which manufactured and erected the bridge.

Running out the bridge. — The bridge when in position is on a gradient of 1 in 100 rising from Nice towards Coni. The bridge was run out horizontally about 6.20 m. (20 ft. 4 in.) above the final position on the Coni abutment, the bearing being taken on steel piers supported by the ogival arch and the two abutments, and especially arranged to allow the bridge to be subsequently lowered into place (figs. 12, 13 and 24.)

The different stages of erection and of running out the bridge are briefly summarized below:

a) Erecting the steel pier on the departure abutment (Coni side);

b) Erection of the nose (in four demountable sections) and of the first fifteen panels of the bridge;

c) Placing the rockers and rollers for running the bridge into position;

d) First stage in the running out of the bridge, the forward end of the bridge overhanging by 15 m. (49 ft. 2 1/2 in.) the abutment; the forward movement was got by means of two winches (one per girder) fastened on the bridge at the back and each hauling on a chain with a tail-sheave moored to the abutment;

e) Erection of the second section of the bridge (nine panels);

f) Second stage in running out the bridge bringing the nose of the extension over the ogival arch;

g) Erection of the pier on the arch and of the roller balancing gear, using the bridge and the extension piece to bring up the material and lower it into place. After getting the bridge to this position in which it takes a bearing on the pier, the longitudinal thrust resulting from forcing the bridge forward by the winches might be dangerous as regards the stability of the ogival arch pier which lies at right angles to the axis of the bridge. In order to avoid this the rollers of the running out rocker gear on the pier and on the first abutment have been fitted with ratchet operating levers which engage a ratchet wheel fastened to the axle of the rollers so making it possible to drive these direct. The alternating movement of the levers turns the wheels one tooth forward at each oscillation and controls in this way the forward movement.

The erection and running out were continued in the following stages:

h) Erection of the last part of the bridge and of the temporary brackets on the rear butt end of the girders, and running out the bridge until the nose of the extension had been brought over the Nice abutment;

i) Erecting the steel pier on the Nice abutment and also the receiving rockers and rollers, proceeding as in the case of the ogival arch pier;

j) Moving the bridge forward until it is brought over its final position;

k) Removing the extension with the exception of the fourth section attached to the girders which will fill the place of the rear brackets for use when lowering onto the bearings;

l) Taking away the balancing gear and rollers and placing the wedges and jacks for lowering.

Lowering onto the bearings. — At the beginning of the operations the bridge is horizontal; its total weight is about 284 tons; the heights by which it is lowered are:

6.20 m. (20 ft. 4 in.) on the Coni abutment.

Figs. 12 and 13. — Steel bridge over the Bévéra. — Running out the bridge.

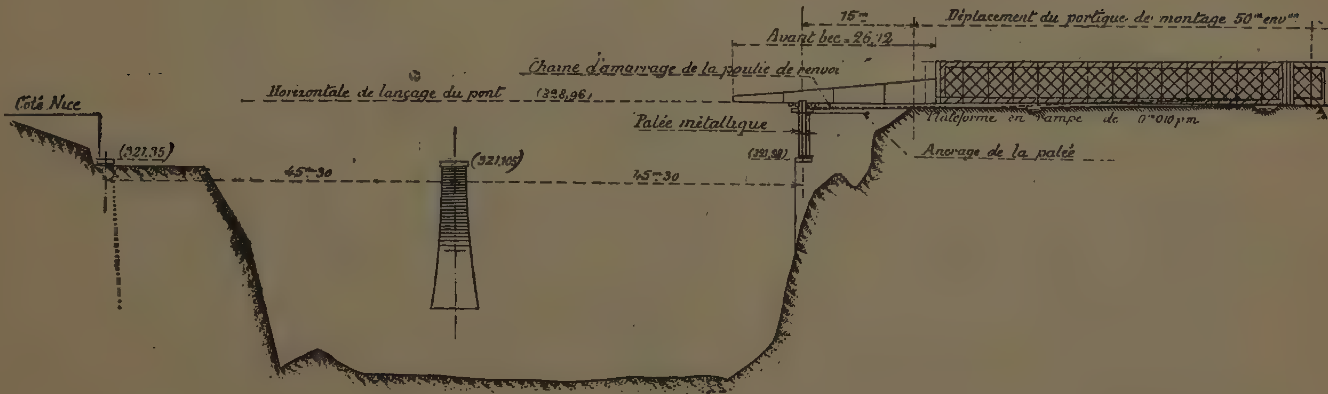


Fig. 12. — First stage of erecting and running out the bridge.

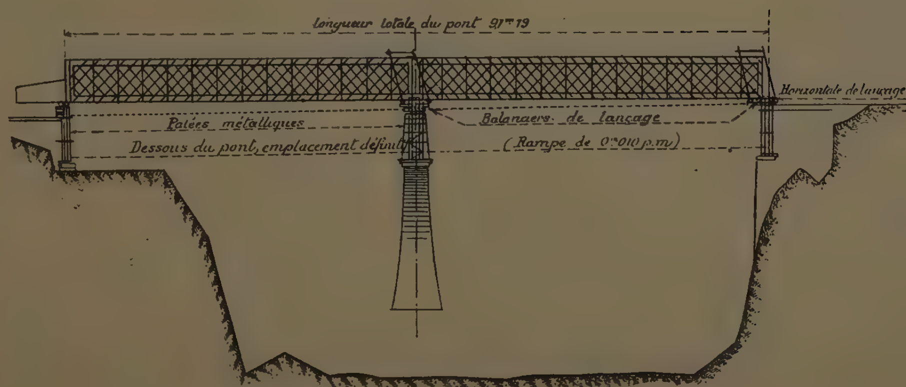


Fig. 13. — Last stage of running out the bridge.

For explanation of French terms, see opposite page.

Explanation of French terms in figures 12 and 13 :

Ancrage de la palée = Anchorage of the pier. — Balanciers de lançage = Rockers for running out the bridge. — Chaine d'amarrage de la poulie de renvoi = Anchorage chain of the tail sheave. — Côté Nice = Nice end. — Dessous du pont, emplacement définitif = Base of the bridge in its final position. — Horizontale de lançage du pont = Horizontal line on which bridge was run out. — Longueur totale du pont : 91.19 m. = Total length of the bridge : 299 ft. 2 1/4 in. = Plate-forme en rampe de 0.01 m. p. m. = Road bed on a rising gradient of 1 in 100. — Rampe de 0.01 m. p. m. = Rising gradient of 1 in 100.

6.65 m. (21 ft. 10 in.) on the ogival arch support.

7.10 m. (23 ft. 3 1/2 in.) on the Nice abutment.

The work was done by successive lowerings onto the pier and alternativ- ely on each abutment, in the following order as shown on the diagram (fig. 23):

1. On the pier	Lowered	0.05 m. (2 inches).
2. On the Nice abutment	—	0.20 m. (8 —).
3. On the pier	—	0.10 m. (4 —).
4. On the Coni abutment	—	0.20 m. (8 —).
5. On the pier	—	0.10 m. (4 —).
2'. On the Nice arch	—	0.20 m. (8 —).

and so on for 6.20 m. (20 ft. 4 in.) down to the horizontal position A′ B′ C″ (on a deflection of 0.05 m. (2 inches) corresponding to the final height of the bridge on the Coni abutment.

Getting the bridge to the slope needed an additional lowering of 0.90 m. (36 inches) at the Nice abutment: it was got by the following operations:

6. On the Nice abutment	Lowered	0.20 m. (8 inches).
7. On the arch	—	0.10 m. (4 —).
8. On the Nice abutment	—	0.20 m. (8 —).
9. On the arch	—	0.20 m. (8 —).

and so on down to the final position ABC.

The lowering was carried out in this way by keeping each girder on its three longitudinal bearings and by giving it in turn first a deflection and then a set upwards of 0.05 m. (2 inches) (figs. 14 to 22).

The lowering operations were carried out in steps of 0.10 m. (4 inches) by means of 50 and 100-ton hydraulic jacks carried on stagings built up of pieces of hard wood 0.10 m. (4 inches) thick. But as the distance to be lowered was too great to allow of the staging being built the full height, the following arrangements were made:

1. *On the abutments.*— The breast-summers carrying the roller balancing gear during the running out, each built up of four I bars of 400 mm. (16 inches) section assembled in pairs were used as a removable platform for the stagings. With this object they were supported by a number of pieces of oak placed vertically 0.40 m. × 0.30 m. (16 × 12 inches) in three sections increasing in length from the top downwards, placed end to end in U irons of 300 × 100 (12 × 4 inches), forming the uprights of the pier and properly fixed so as to avoid any buckling. The removal of these vertical wooden sections and the substitution in turn of the shorter for the longer lengths made it possible to have six successive levels for the removable iron frame. The height of the stages under the jacks in this way never exceeded 0.90 m. (2 ft. 11 1/2 in.).

Figs. 14 to 22. — Lowering the bridge on to its supports.

Figs. 14 to 15. — Arrangement of packings for lowering the bridge.

Elevation of the pier.

Fig. 14. Longitudinal section on the centre line.

Fig. 15. First step in lowering the bridge.

Fig. 16. First lowering of the removable steel joists.

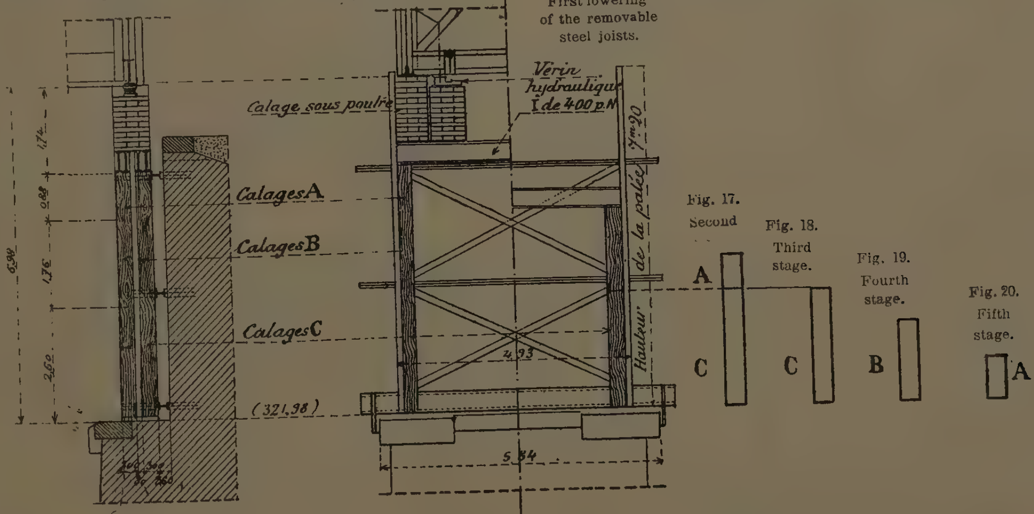
Figs. 16 to 20. — Arrangement of the vertical packings for lowering the removable steel joists.

Fig. 17. Second

Fig. 18. Third stage.

Fig. 19. Fourth stage.

Fig. 20. Fifth stage.



Figs. 14 to 20. — Steel bridge over the Bévéra. — Structure on the abutment.

Explanation of French terms : Calages = Packings. — Calage sous poutre = Packings under girder. — Hauteur de la palée = Heigh of the pier. — Verin hydraulique = Hydraulic jack.

Fig. 14 to 22 (*continued*). — Lowering the bridge on to its supports.

Fig. 21. — Cross section on the centre line of the pier. Fig. 22. — Longitudinal section on the centre line of the pier.

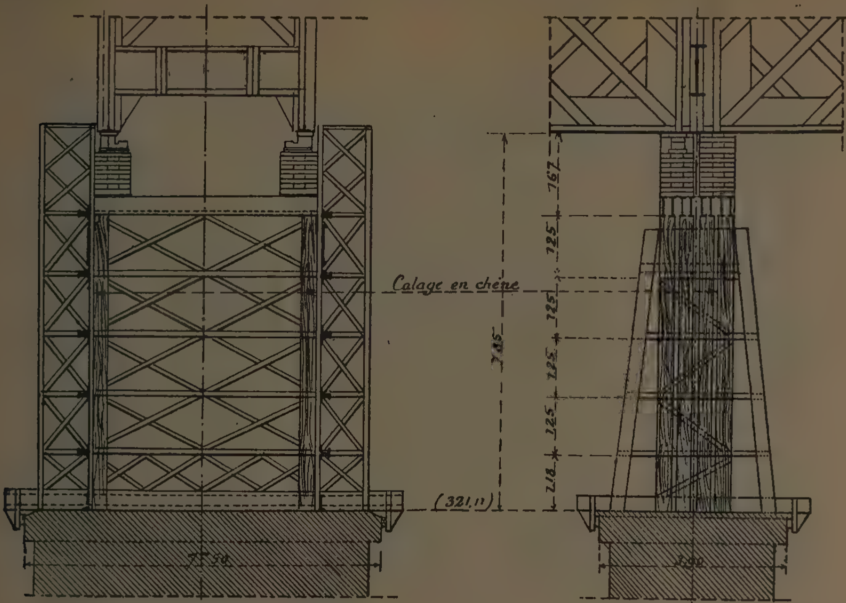


Fig. 21 to 22. — Steel bridge on the Bévéra. — Structure on the pier.

Explanation of French terms: Calage en chêne = Oak packing piece.

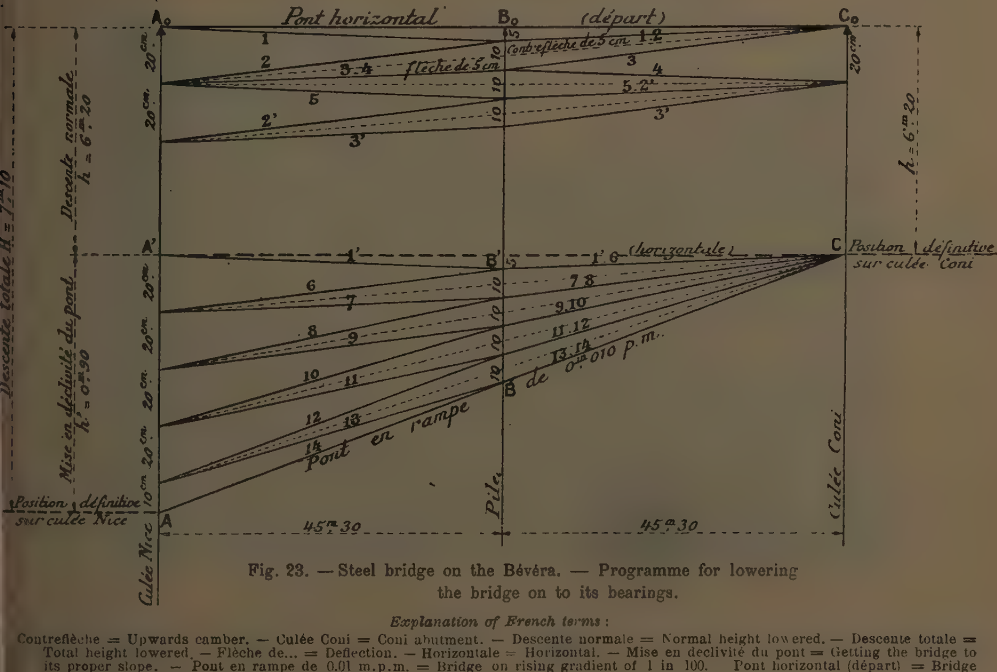


Fig. 23. — Steel bridge on the Bévéra. — Programme for lowering the bridge on to its bearings.

Explanation of French terms:

Contreflèche = Upwards camber. — Culée Coni = Coni abutment. — Descente normale = Normal height lowered. — Descente totale = Total height lowered. — Flèche de... = Deflection. — Horizontale = Horizontal. — Mise en declivité du pont = Getting the bridge to its proper slope. — Pont en rampe de 0.01 m.p.m. = Bridge on rising gradient of 1 in 100. Pont horizontal (départ) = Bridge in horizontal position (start). — Position définitive sur culée Coni = Final position on the Coni abutment. — Position définitive sur culée Nice = Final position on the Nice abutment.

Fig. 24. — View of the Bévéra bridge after being run out, but before being lowered on to its supports.

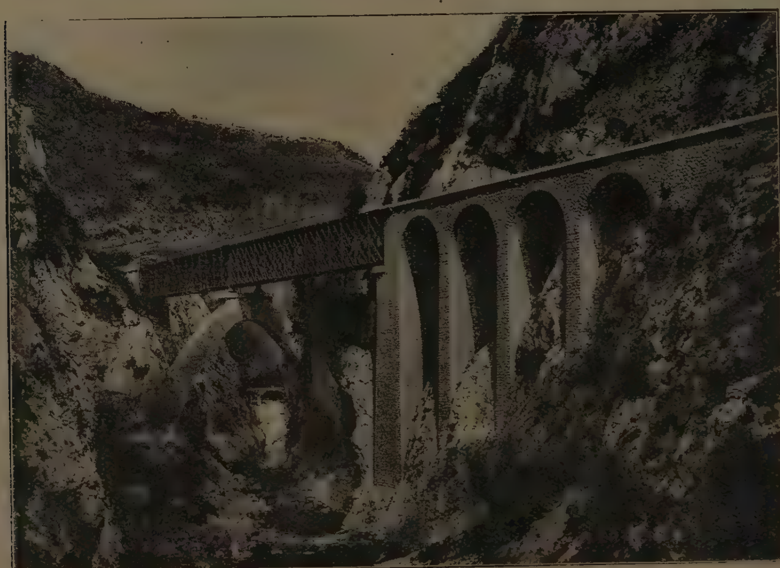


Fig. 25. — View of the Bévéra bridge in its final position

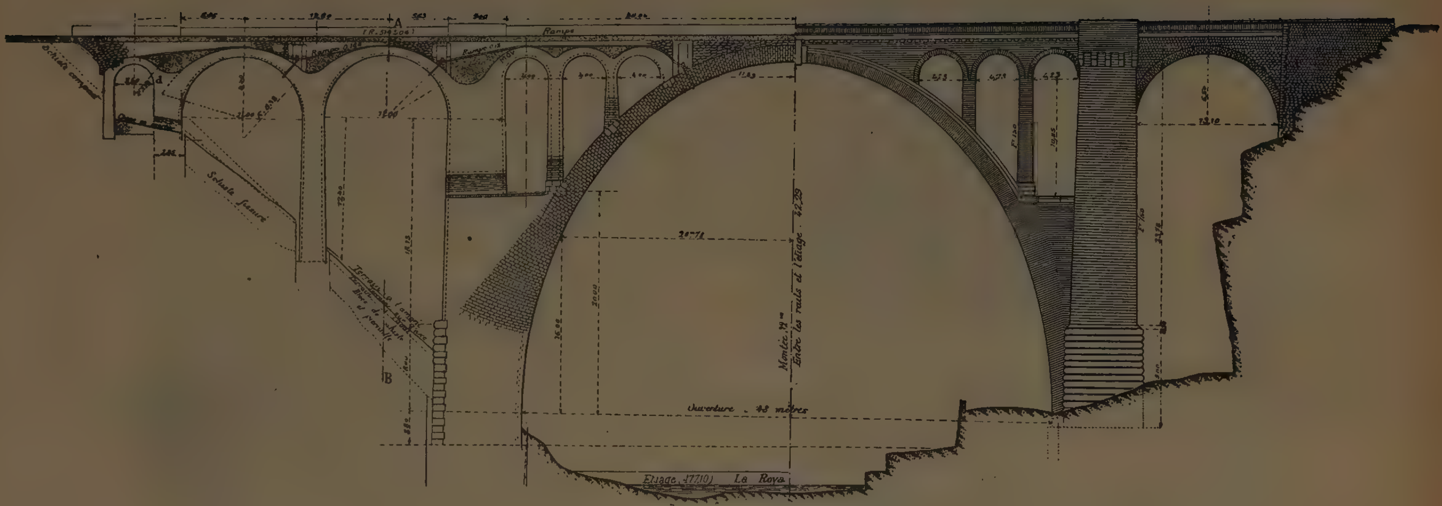


Fig. 26. — Scarassoui masonry bridge over the Roya. — Half section and half elevation (up stream side).

Scarassoui masonry bridge over the Roya.

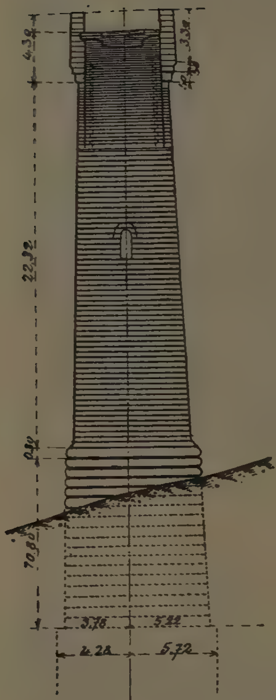


Fig. 27. — Section through A B (fig. 26).

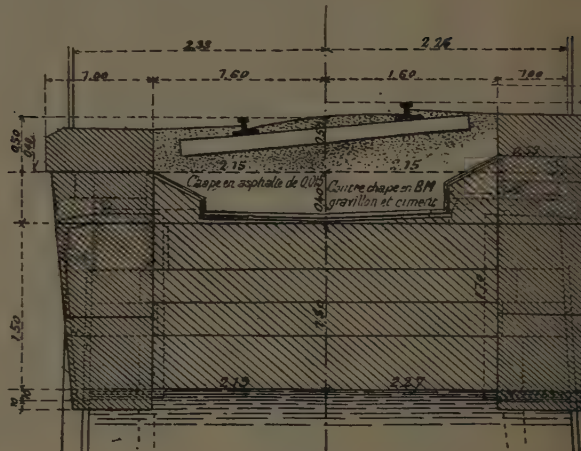


Fig. 28. — Cross section through the crown.

Figure 15 shows the method of packing up the bridge on the iron frames, there being for each girder a packing under the girder to receive the bridge after each lower of 0.10 m. (4 inches), and to allow of lowering the jack and starting again.

To lower the removable iron frame onto a pier, the bridge was carried on the corresponding abutment, by brackets built on to the butt ends of the girders and taking bearing on the masonry work through a hard wood packing. The manœuvre of lowering was carried out as follows:

Packing up the bridge on the masonry by means of the brackets;
Releasing the jacks;
Removal of one vertical section of the staging under the built up iron frames;
Lowering the removable iron frames;
Refitting the packings and jacks on the breast-summers;
Removal of the brackets which are then refitted to the buttends of the girders in a suitable position for the next operation.

2. *On the pier.* — The lay-out is the same but the removable steel girders to the number of eight form two independent breast-summers each carrying, in line with each girder, a jack carrying packing; a bridge bearing packing, at the end of each lower of 0.10 m. (4 inches). The lowering of the two breast-summers is carried out separately, the bridge being carried by the packings of one when the other was being lowered.

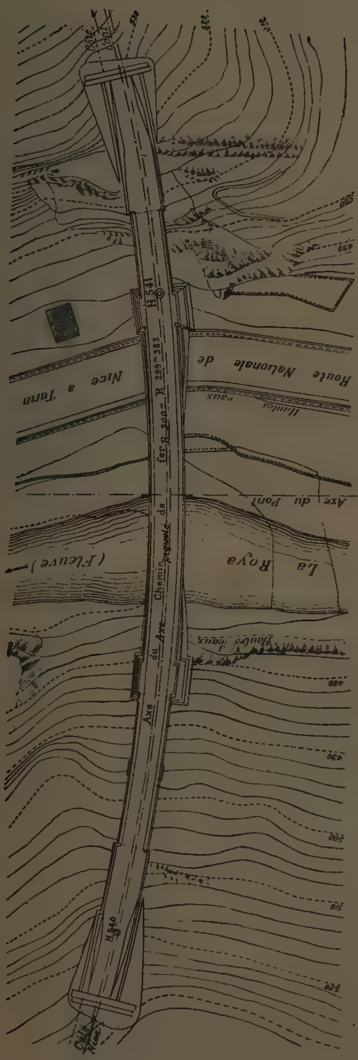


Fig. 29. — Scarassoui masonry bridge over the Roya. — General plan.

When again starting to lower the removable steel girders, positions of the bridge were chosen at which the reactions were minima on the bearing concerned that is to say: on the abutments when the bridge was set upwards; on the pier when deflected.

Escarène viaduct. — The maximum height of this structure which crosses the river Redebraus is 38.94 m. (127 ft. 9 in.) with a total length of 220 m. (722 ft.); it has eleven round arches of 15 m. (49 ft. 2 1/2 in.) span.

The piers having a thickness varying from 2.40 m. to 2.95 m. (7 ft. 10 1/2 in. to 9 ft. 8 1/4 in.) show in elevation and in the transverse sense a parabolic batter; the spandrels have a batter of 1/40. The proportions of this viaduct are very pleasing as can be seen from figure 7.

Eboulis viaduct. — Situated on the Vintimille branch on the right bank of the Roya at the foot of an enormous land slide, this viaduct built over the land slide (fig. 1) has large spans so as to offer large passage ways in the event of any future slip.

It consists at the land slip, of eight arches of 18 m. (59 feet) and on both sides thereof two small approach viaducts with 7 m. (22 ft. 11 5/ in.) arches separated from the centre part by two massive pier abutments marked by two newals crowned by plain parapets carried on corbels.

On the side facing the mountains, four of the piers of the central part lightened below the spring of the arches, are provided with cutwaters with the object of dividing the mass of material that might come against it if any further slip should occur.

Scarassoui bridge. — The first French structure seen when coming from Italy; it is the gateway into France of which role it is eminently worthy.

This bridge (figs. 26 to 29) crosses the

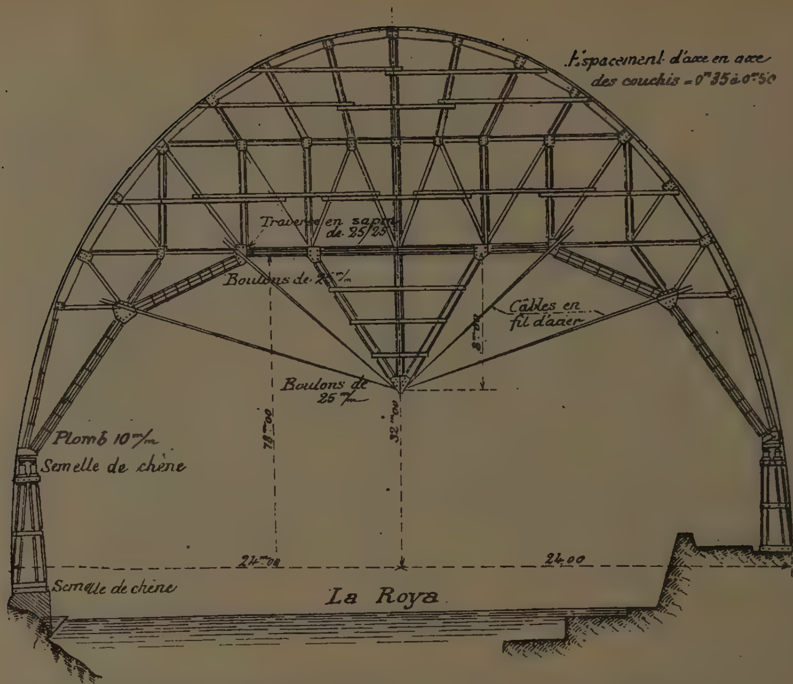


Fig 30. — Scarassoui masonry bridge, over the Roya. — View of the centering (down stream side.)

Explanation of French terms : Boulons de 25 m/m = 63/64-inch bolts. — Cables en fil d'acier = Steel wire cables. — Espacement d'axe en axe des couchis-0.35 à 0.50 m. = Distance between centering of the footing block-13 3/4 to 19 11/16 inches. — Plomb 10 mm. = 3/8-inch lead. — Semelle de chêne = Oak footing block. — Traverse en sapin de 25/25 = Pine transoms (10 × 10 inches).

Fig. 31. — Construction of the Scarassoui bridge over the Roya.

Fig. 32. — View of the Saorge masonry bridge.

Fig. 33. — Erection of centering of the Saorge bridge.

Roya 42.30 m. (138 ft. 9 in.) above it; it is on a 300 m. (15 chains) curve and on a rising gradient of 1 in 47. The elliptical stilted arch has an opening of 48 m. (157 ft. 5 3/4 in.), a rise of 32 m. (105 feet) with spandrels lightened by six small round arches, and framed by two pier-abutments standing out and forming newals. It is completed by two plain arches of 11 m. (36 ft. 1 in.). The thickness at the keystone is 1.50 m. (4 ft. 11 in.). The bands are relieved by a curved moulding of simple profile; the pilasters with marked bosses are carried on a foundation of large blocks of stones.

In structures built on curves, the arches usually are cradle vaulted on the rectangular plane; the structure is thereby enlarged by the spring of the curve and there is an unpleasing difference in thickness between the pilasters and the piers on the upstream and on the downstream sides.

In this case the soffit is a convoid originated by a horizontal resting on the one hand on the vertical through the centre of the layout and on the other on a director formed by an elipse situated on the vertical plane tangent to the layout at the middle of the opening. This is the only method of ensuring that the width of the pilasters is satisfactory at the same time on the two elevations of the bridge. The adoption of a soffit of convoid form has not caused any particular difficulty; all that was needed was to vary in an imperceptible manner the thickness of the mortar joints, from one head to the other.

The two spandrels are finished on the lines of cones having a vertical axis, the generatrix being inclined 2 % (concave side) and 6 % (convex side) : from this side, no point of the soffit overhangs any lower point, a result obtained by using the formula established by M. Séjourné in his book « Grandes voûtes » (Large Arches) (1). (Vol. VI, p. 88).

$$\text{Batter, convex side} = \frac{r\left(\begin{array}{c}\text{radius of curvation from}\\ \text{the soffit to the key-stone}\end{array}\right) = 18 \text{ metres}}{\text{R (radius of the lay-out)} = 300 \text{ metres)}}.$$

The structure was built on fan-shaped centering with cables (fig. 31) following the pattern designed by M. Séjourné for the wellknown Luxembourg Bridge (1); these cables of steel wire act on a king post and are secured by stirrups to the knuckles of the trestle shore; the tension is very easily regulated by means of the nuts on the stirrups.

The use of tightened up cables in the raised arches makes it possible to correct defects such as settling of the crown; for this all that is needed is to increase the tension in the cables by tightening the nuts of the stirrups. Inversely by loosening the nuts, the crown can be dropped and if the arch is keyed, striking the centering can be effected in this way.

The tension of a cable is measured by its sag, which is read off on a graduated board placed at the middle of the cable.

Saorge bridge. — This is the second bridge seen in France when coming from Italy. It crosses the Roya valley at a height of 59.22 m. (194 ft. 3 1/2 in.) by a masonry arch of 40 m. (131 ft. 2 3/4 in.) span flattened 1/3.5 on a rising gradient of 1 in 50. The depth at the crown is 1.48 m. (4 ft. 10 1/4 in.).

(1) See the detailed review of this work in the *Génie Civil* of the 15 December 1927, (Vol. LXXI, No. 24, p. 385).

(1) This bridge was described in detail in the *Génie Civil* of the 18 January 1902, (Vol. XL, No. 12, p. 185).

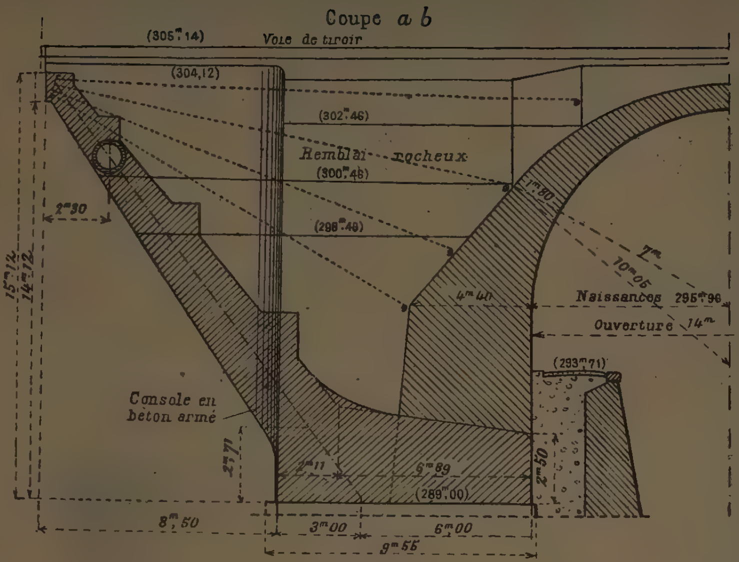


Fig. 34.

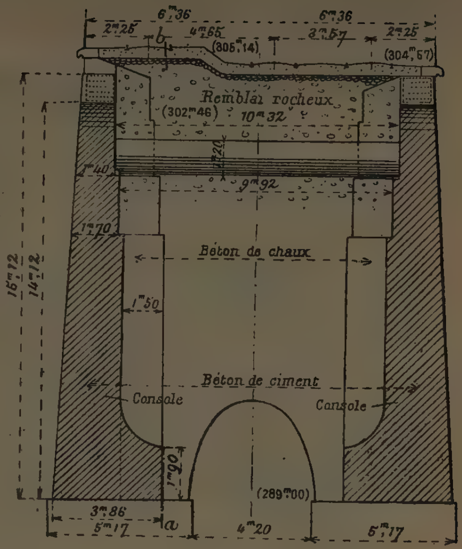


Fig. 35.

Figs. 34 and 35. — Longitudinal and cross sections (through one abutment) of the bridge over the Lavina showing the construction of the reinforced concrete brackets which support the wing walls.

Explanation of French terms in figs. 34 and 35 :

Béton de chaux = Lime concrete. — Béton de ciment = Cement concrete. — Console = Bracket. — Console en béton armé = Reinforced concrete bracket. — Coupe *a b* = Section *a b*. — Naissance = Spring of the arch. — Ouverture = Span. — Remblai rocheux = Rock filling. — Voie de tiroir = Draw out track.

Fig. 36. — Abutment on the Nice side of the bridge over the Lavina with reinforced concrete brackets supporting the wing walls.

The plain soffits have a batter of 25 mm. (63/64 in.). It was felt desirable to give a simple appearence to this structure which is seen from far below and which spans a wild gorge (fig. 32).

The up-turned and fan-shaped centering with cables (fig. 33), is like that of the Scarassoui bridge; it was erected by means of a wire rope strung from one bank to the other by means of which the different parts of the centering were conveyed and put into position in turn. This work was carried out successfully by the contractor, M. Borie, who also built the Scarassoui bridge.

Arch bridge of 14 m. (45 ft. 11 in.) Span over the Lavina. — Reinforced concrete brackets of 8.50 m. (27 ft. 11 in.) projection and 15.12 m. (49 ft. 7 1/4 in.) high under the flank walls of the Nice side abutment. This bridge rests on a bed of compact gypsum very much inclined, sloping towards Nice. The foundation on the Coni side is only 2.20 m. (7 ft. 2 1/2 in.) deep, whereas that on the Nice side is 16 m. (52 ft. 6 in.).

Had it been desired to build the flank walls of this same abutment on the gypsum, it would have been necessary to sink the foundation 22 m. (72 ft. 2 1/8 in.). In order to avoid such costly foundations, each of the flank walls of the abutment on the Nice side rests, as shown in figs. 34 to 36, on a great bracket in reinforced concrete, projecting 8.50 m. (27 ft. 10 5/8 in.) and 15.12 m. (49 ft. 7 1/4 in.) in height [1].

These brackets are connected together at their upper end by a hollow cylin-

[1] It may be remembered that the reinforced concrete brackets of the Batignolles cut, just outside the Gare Saint Lazare at Paris, designed by Mr. Rabut and considered a very bold conception at that period (1910), have only 7 m. (22 ft. 11 5/8 in.) overhang. (See on this subject the *Génie Civil* of the 1 and 8 October 1910 (Vol. 22 and 23, pp. 409 and 419).

drical crossbar, in reinforced concrete, 1.20 m. (3 ft. 11 1/4 in.) in diameter and 0.20 m. (7 7/8 inches) in thickness.

The flanks of the brackets are prolonged as far as the under face of the arch. The wing wall rests therefore on the ends of the flanks and effectively contributes to the stability of the construction.

To ensure that the top ends of the bracket will not move, and to prevent the masonry cracking, four layers of round steel bars embedded in the masonry acting as tie rods counterbalance the thrust due to the open space (fig. 34).

This brief description of a line which happily completes the alpine section of the Paris, Lyons & Mediterranean Company's system, may be ended by stating that the designing and construction works were in turn under: Messrs. Geoffroy, Assistant Manager until 1909; Séjourné, Assistant Manager until 1927; Martinet, Engineer-in-chief for new work since 1927; the Engineers - in - chief, Canat de Chizy, until 1911; Martinet from 1911 to 1924, and Bastien from 1924.

As for the contractors, only those who carried out the most important works can be mentioned here; they were Messrs. Orizet, Gianotti Brothers, Mercier, Borie; the Baudet, Mercier, Donon & Roussel Company; the « Construction Métallique Haut-Marnaise »; Messrs. Pelnard-Considère & Caquot, and M. Thorrand.

[621 .139 (.44), 625 .18 (.44) & 625 .27 (.44)]

Organisation of the stores department of the technical services of the French Eastern Railway.

Figs. 1 to 6, pp. 811 to 819.

The Technical Departments of the Eastern Railway amongst other duties are responsible for purchasing, stocking and supplying to the stations, works, and the various services of the system a considerable quantity of material including especially telegraph, telephone, and train control instruments, lighting equipment; office supplies and printing matter; the number of items stocked is about 18 400, of a value at the end of December 1926 of 11 300 000 francs; the value of the material issued during the year 1926 amounted to 31 300 000 francs.

The extension of the Gare de l'Est in 1924 involved the pulling down of the buildings in which this work had been handled; it was decided at that time to transfer the stores to an old works purchased by the Company at Noisy-le-Sec, the purchasing office and the accounts remaining at Paris.

Principes observed in the reorganisation.

The reorganization of the stores and their installation at Noisy-le-Sec were carried through with the assistance of Mr. Bertrand Thompson and of Mr. Planus in accordance with the following principles :

I. — *Supplying orders sent in by the requisitioning Departments.*

The orders are sent forward in the shape of an order note carrying a list of the articles wanted. The work consists in collecting these articles together in the stores, packing them up, and sending them away. In accordance with the principle of the division of labour, these different operations are dealt with by different men.

A. The collection of the articles is done by a storesman, who, with the order note, goes through the stores and puts the parts into a basket on rollers as he collects them.

In order that the collection may be done in the shortest possible time, the route taken by the storesman when collecting the articles on a single note, must be as short as possible. The following plan was therefore adopted :

a) The stores have been divided into two parts; issuing stores containing three or four weeks consumption of each article, and a reserve store containing about three months supply of each of the same details. The storesman only works in the issuing stores which is small in size so that the distances also are short. When the storesman, in going round, observes the stock of any article is getting low he arranges for the stock to be brought up again from the reserve stores in the manner described further on;

b) The articles shown on the note by the requisitioning department are given in such an order that the storesman has

no need to make any countermarch; the requisitioning department, with this object in view, inserts the articles asked for on the note in the order given in a stores vocabulary supplied to it, this order being devised for this purpose;

c) In order that the storesman can easily get at the articles he has to deal with, the parts are not stocked at a greater height than 1.80 m. (5 ft. 11 in.); they are easily seen and well-lighted.

B. When he has collected the articles together, the storesman hands them with the note to a checker who sees that all the parts required have been supplied and that articles not asked for have not been issued.

C. The checker then hands over the whole of the articles collected together to a packer.

D. A labourer then takes the package to the dispatching shed.

II. — *Accounts.* — *Stores.* *Keeping stocks in the stores.*

In order to simplify the accounting, it has been decided not to take stock of the articles in the issuing stores. To keep account of this part of the stores would as a matter of fact make it necessary to record, article by article, everything issued against each order note; which would make the work very complicated. For this reason only the reserve stocks are accounted for [1]; the accountancy work is done in an office close to the stores; for each article there is a corresponding « stores balance card » on which are written both the receipts and the issues; the office keeps track of these by means of receipts slips received each time any material comes into the stores and by issue slips each time goods pass from the reserve to the issuing stores; the office thereby knows the stock position at all times and can arrange in sufficient time for fresh supplies of those articles of which the stock is getting low.

To ensure that these fresh supplies are obtained, the following arrangements have been made: each card shows the minimum quantity below which the stock is not to fall without steps being taken to replenish it; this limit quantity is not fixed, it depends upon the consumption and also upon the ease or difficulty of getting fresh supplies; it is therefore revised at intervals. When the clerk dealing with the stores balance cards receives an issue slip from the reserve to the issuing stores and in writing this issue onto the card notices that the stock has fallen below the limit figure, the purchasing section is sent a request for fresh supplies; the quantity to be ordered is also shown on the card so that it has only to be transcribed on to the demand note.

On the back of the stores balance card the clerk notes the demand note sent to the purchasing department; a note is also made when the order has been placed by the purchasing department which supplies a copy of the order. In this way the clerk is kept constantly informed as to the orders in hand.

Realisation.

The installation of the stores in the old works at Noisy has been carried out on these bases, in the following fashion (see plan, fig. 1):

(1) Arrangements have been made for periodical check tests to be made in the issuing stores.

Incoming stores.

Goods supplied by contractors are brought in by rail or road; in the former case they are off-loaded at the platform A alongside the siding, and in the latter at platform B; in both cases they are taken into the reception shed C, where they are checked for quantity and quality; the checker with this object in view is supplied with a copy of the order as sent to the contractor; with this copy he can recognize the goods, check the deliveries, and prepare, for those accepted, a receipt note in triplicate.

The material accepted with the receipt note is then sent to the reserve stores where it is put in stock.

Arrangements of materials in the reserve stores.

The reserve stores consists of several buildings, some of which are heated and some not; some of the storerooms are on the first floor and some on the ground floor.

In addition the whole of the material stocked has been divided into three sections consisting of :

1st Section, telegraph, telephone, and lighting material;
2nd Section, office and station stores;
3rd Section, stationary.

The area of the store sheds D, E and F on the plan (fig. 1) is as follows :

D. (Ground floor : heated) . . . 672 m² (7 233 square feet).

E. (Ground floor : not heated). 1 125 m² (12 110 square feet).

F. (First floor : heated). . . . . 1 388 m² (14 941 square feet).

The total area of all the stores buildings is therefore nearly 3 200 m. (34 445 square feet); this area was calculated as being sufficient to allow of an extra 25 % of stores above that held at the time of transfer, to be stocked under normal conditions, and of an extra 50 % for a short period.

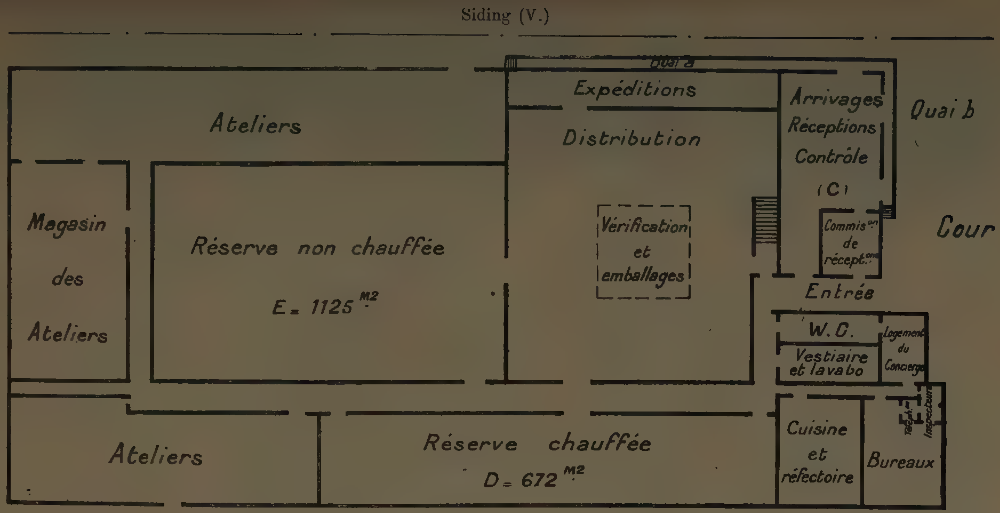
The materials to be stocked are distributed between the different warehouses according to their fragility and also to the effect frost and damp have upon them; the most delicate materials are stored on the 1st floor, those adversely affected by damp or cold in the heated stores.

In the reserve stores the articles as a rule are stored on racks; these racks take standard wooden cases 0.60 m.(24 inches) wide, 0.60 m. (24 inches) high, and 0.50 m. (20 inches) deep inside. Each rack holds five sets of cases, 3 m. (9 ft. 10 1/8 in.) high. Wooden partitions are used to divide the standard cases in two, four, or eight sections, according to the volume of the articles to be stored; these sections are in the form of open lidless boxes in thin white wood, 10 mm. (13/32 inch) thick, planned down to 8 mm. (15/16 inch) and measuring 0.60 m. (24 inches), 0.30 m. (12 inches), or 0.15 m. (6 inches) in width by 0.30 m. (12 inches) high by 0.50 m. (20 inches) deep outside.

Some parts are stacked in piles, as for example cases of lamp-bulbs, boxes of sal ammoniac, boxes of dry cells, etc. Others are stacked in stalls; cordage, brushes, flags, etc.

The racks are arranged back to back; between the lines of racks the alley ways are 1.20 m. (3 ft. 11 in.) wide.

The sections of the stores are designated by a number; the alley ways by a letter; the columns of a rack of cases or of stalls by a second number; the cases



First floor.

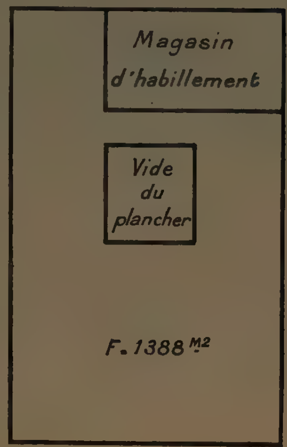


Fig. 1. — Stores of the Technical Departments at Noisy-le-Sec.

Explanation of French terms : Arrivages = Incoming section. — Ateliers = Shops. — Bureaux = Offices. — Commis. de récep. = Staff checking stores received. — Contrôle = Check. — Cour = Yard. — Cuisine et réfectoire = Kitchen and mess room. — Distribution = Issuing store. — Entrée = Entrance. — Expéditions = Outgoing section. — Logement du concierge = Watchman's quarters. — Magasin des ateliers = Shop stores. — Magasin d'habillement = Clothing stores. — Receptions = Receiving section. – Reserve chauffée = Reserve stores, heated. — Reserve non chauffée = Reserve stores, unheated. — Vérification et emballages = Checking and packing. — Vestiaire et lavabo = Cloak room and lavatories. — Vide du plancher = Opening through the floor.

in a single column by a second letter; each place is in this way shown by a group of two letters and two numbers; the case 3 A 4 C for example, is the 3rd in height of the 4th column of alley way A in section No. 3 of the stores.

The receipt note in triplicate which accompanies the goods coming into the stores, bears in accordance with this method the indication of the place where the material should be stacked; the storesman is therefore given every guidance in getting it to its right place.

Moreover, at the case or stall in which the storesman places the material, there is hung up a ledger card on which the stock is written; the storesman removes this card and replaces it by a new one on which he has inserted the quantity remaining and the quantity received. The total gives the new value of the stock.

The storesman then sends the old card to the clerk dealing with stores balances and the three copies of the receipt note to the reception clerk, after signing them so as to certify that the material has been put into the proper place in the stores.

The original of the receipt note is sent by the reception clerk to the purchasing department which is thereby notified that the order has been completed and arranges for the supplier to be credited by the Accounts Department, the second copy is sent to the clerk dealing with the stock balance cards so that the receipt in to the stores may be recorded on the balance cards. The third copy is retained by the reception clerk who files it.

Stocking the issuing stores from the reserve stores.

The issuing stores are supplied from the reserve stores as follows :

At each place at which in the issue stores goods are stored, a ticket carried on a hook gives the description and classification number of the material, the code showing its position in the issuing and in the reserve stores, the minimum stock at which further supplies must be ordered from the reserve stores and the quantity the reserve stores should order when in collecting stores, the storesman sees the stock is getting close to the figure of minimum stock on the card, he writes out an issue note from the reserve to the issue stores, inserting on the note all the indications mentioned above and sends it to the reserve stores.

The storesman of the reserve stores reads off from the issue note the position of the stores asked for, to which he goes and marks on the ledger card described above the quantity issued and calculates the balance, after which he delivers to the issuing stores the goods accompanied by the issue note; this note after being marked up, is sent to the office where a note is made on the corresponding ledger card of the material issued.

The accounts ticket and the stores balance cards in this way check one another; each day employees known as « stock balances checkers » go through a certain number of cards and tickets; if any differences are found the cause is looked for and the errors corrected .

Issuing stores.

In the issuing stores the materials are stocked in standard racks identical with those in the reserve stores; the only difference is that instead of being in five stories, the cases are stacked in three, so that the storesman can get at the whole of them from the floor level. For very small parts (labels, screws, etc.) small

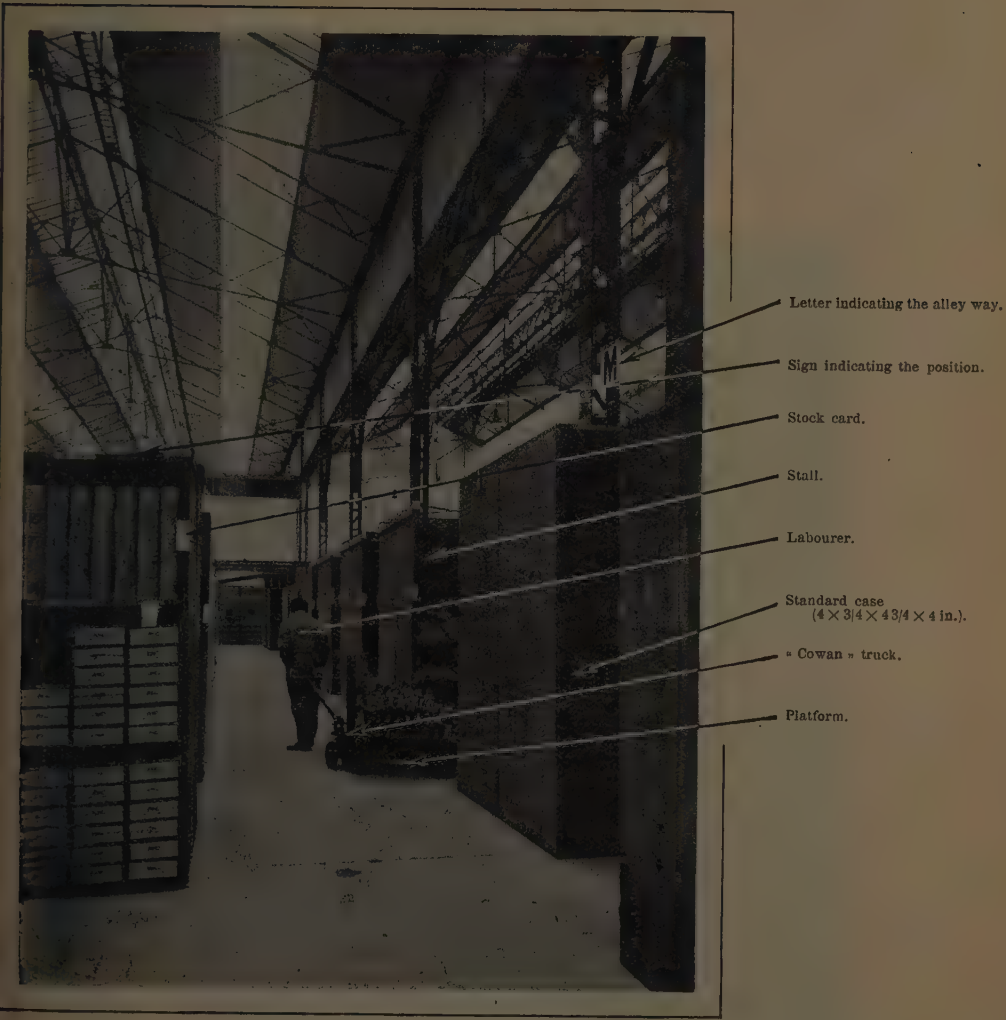


Fig. 2. — Reserve stores.

Fig. 3. — Post of clerk dealing with store balances.

drawers fitted into a certain number of the racks are provided.

The issuing stores, like the reserve stores, are divided into three sections :

Telegraph, telephone, and lighting materials;

Office stores and small stores for station use;

Printed matter.

These three sections are run independently; the demands sent in by the departments have to be divided amongst as many notes as there are sections affected; the stores requisitioned have to be shown in accordance with the general stores list supplied to all the requisitioning departments.

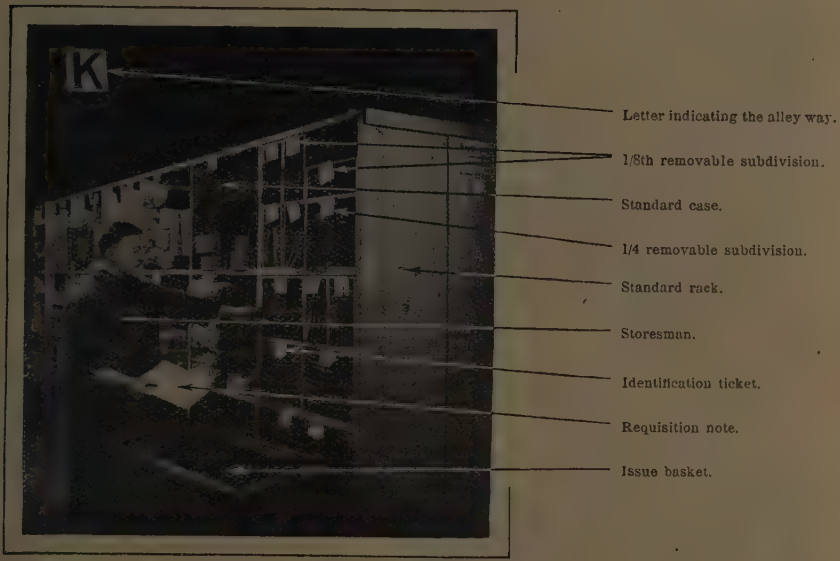


Fig. 4. — Issue.

Receipt of the requisitions.

Each requisition note received at the stores is first of all registered so that all notes not completed may be checked. The note then passes to the clerk dealing with the ledger balances of the section concerned. The balance cards are in fact divided into three groups corresponding to the three sections of the stores; each group is dealt with by one or two clerks. Each clerk also keeps a register called the « price list » in which is written the average price for each kind of goods of the quantity in the stores. This average price is obtained in this way; each time

a receipt note is received by the clerk dealing with the ledger balances cards, a note is made on the card corresponding to the goods received, of the quantity received and the total cost. The quantity received is added to the quantity still in stock. The total cost of the quantity received is added to the total cost of the remainder in store. A simple division gives the average cost of the new stock figure. This average price is used when a further quantity is received into store to calculate the total value of the stock remaining when this delivery was received. It will be seen that every time material is received into the stores, it may be necessary to alter the average price; the new price is marked in pencil on the « price list ».

The clerk dealing with the ledger balance cards, on receiving a note, marks against each article the average price shown on the price list; the note is then sent to the head of the issuing stores.

Preparation of material for dispatch.

The head of the issuing stores distributes the notes between the storesmen; the storesman dealing with any particular note enters his own number on the note, then with the note and a basket fitted with castors, he collects the stores requisitioned; against each item he inserts the quantity taken (1). When the round is ended, he places the note in the basket which he leaves in the place set aside for checking; this place is marked by painted lines on the floor.

If any one note needs several baskets, tickets are placed on them all to show that they belong to the one order.

(1) The quantity taken may not be the whole quantity asked for if there is any shortage. In this event, an extract is made frcm the order, as will be described later on, and is put aside until it can be met in the same way as the requisition note proper.

Checking materials sent out.

The baskets are checked in the following manner :

The checkers make use of a bench which can be divided into sections of 1 m. (39 1/2 inches), 1.50 m. (59 1/4 inches), or 2 m. (79 inches), in width; the checkers work on one side of the table, the packers on the other; the checkers stand in a sort of well sunk in the floor 0.80 m. (31 1/2 inches) wide by 0.25 m. (9 7/8 inches) deep; this arrangement enables the checkers to examine the contents of the baskets which stand on the edge of the pit without having to bend too much; all material corresponding to a particular note is taken from the basket, or baskets, holding it, and is checked to see that the quantities agree with those the storesman has shown on the note : the quantities in question are ticked off on the note and the articles as checked are placed in one of the spaces. If there is any mistake the checker points it out to the storesman whose number is on the requisition note, and the mistake is at once corrected.

Packing and dispatching.

The articles collected in the same section should then be packed up; the packers work on the checking table on the opposite side to the checkers; they use a moveable table; cases and empty baskets are stacked close by; rolls of packing paper, string, lead seals, etc., are conveniently placed close at hand.

The packer then does up the articles in the section; he marks on the note his number as well as the number used for the packages and attaches the note and the duplicate to the last parcel; he then places the parcels on a gravity runway

ending at an automatic weighing machine.

The labourer who has to transfere the parcels to the despatch shed, notes the weight on a weighing machine slip which he attaches to the duplicate copy of the note.

When the despatch note has been written out, the note and its duplicate are sent to the office dealing with stores balances, where an extract is made should the quantities delivered be less than those requisitioned.

The notes and copies are then sent to a typist provided with a calculating machine as well as a typewriter; this typist calculates, according to the quantities supplied and the unit price, the cost of the material delivered which is typed on the requisition note in the column provided for the purpose; the sum total of the costs given by the totalisator of the calculating machine is typed on the note.

The notes and duplicates are then handed to the employee responsible for recording the packages, who takes a note of the number of the cases and baskets so as to see they are returned. The notes without the duplicate copies are then sent to the ordering departments for information and the copies are classified in alphabetical order and by number. The signed order notes are sent to the accounts department which debits the requisitioning department with the amounts invoiced.

Purchasing department.

The purchasing department is at Paris; each article stored in the Noisy stores has its file in which are entered the names of the firms to be invited to quote, and in which are classified the replies received to the last enquiries sent out for prices. When the Noisy stores send in a purchasing order to the purchasing department, after being booked in, the order with the relative papers is put before the head of the department; he then decides if further tenders should be invited or if the order should be placed immediately.

The tenders are invited by a clerk specially responsible for this work, who in addition, follows up the enquiries outstanding and repeats when replies are late in coming in.

When the contractor with whom the order ought to be placed has been selected by the chief buyer or by the head of the purchasing department if it is a question of an important decision, the order itself is prepared in six copies :

The first copy is for the contractor;

The second copy should be returned by him as acknowledgement;

The third is sent to the receiving agent who will have to see that the material is checked in the stores;

The fourth is sent to the clerk dealing with stock balances to note that the requisition to purchase is being dealt with;

The fifth and sixth copies are given to an employee who follows up the delivery of the material ordered, and presses the contractor for it as need be. This employee is immediately notified of all receipts by the receiving staff at the Noisy stores.

The staff employed on the purchasing side is at the present time much greater than before the reorganization; there are 15 employees instead of 7; the custom had arisen of obtaining certain supplies always from the same firms, but it was found to be cheaper to get the greatest possible number of firms into competition and to issue tenders frequently and widely. The resulting saving in the pur-

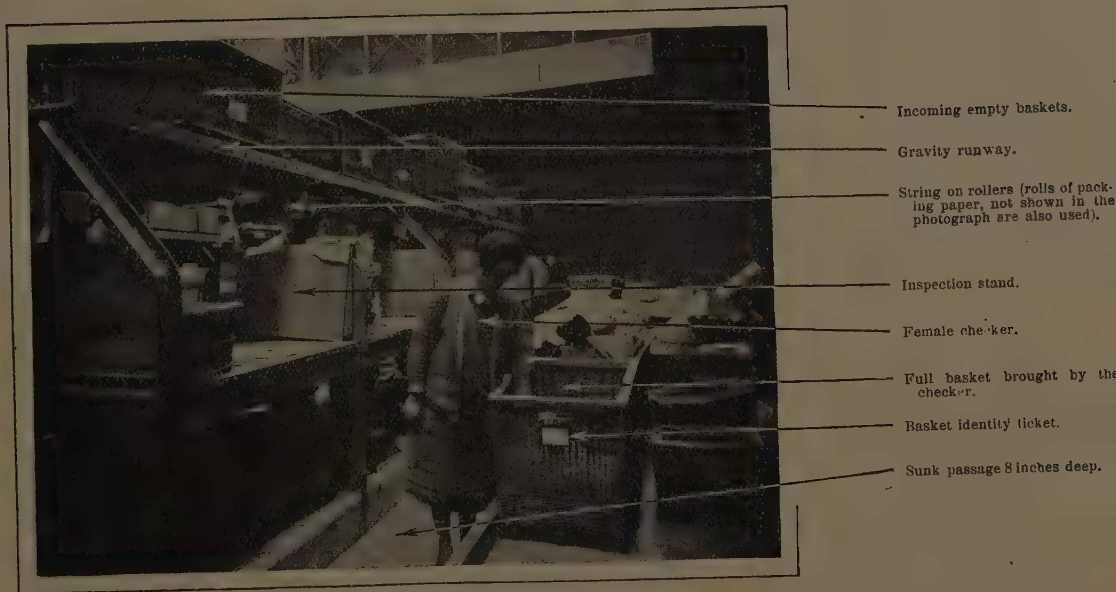


Fig. 5. — Checking.

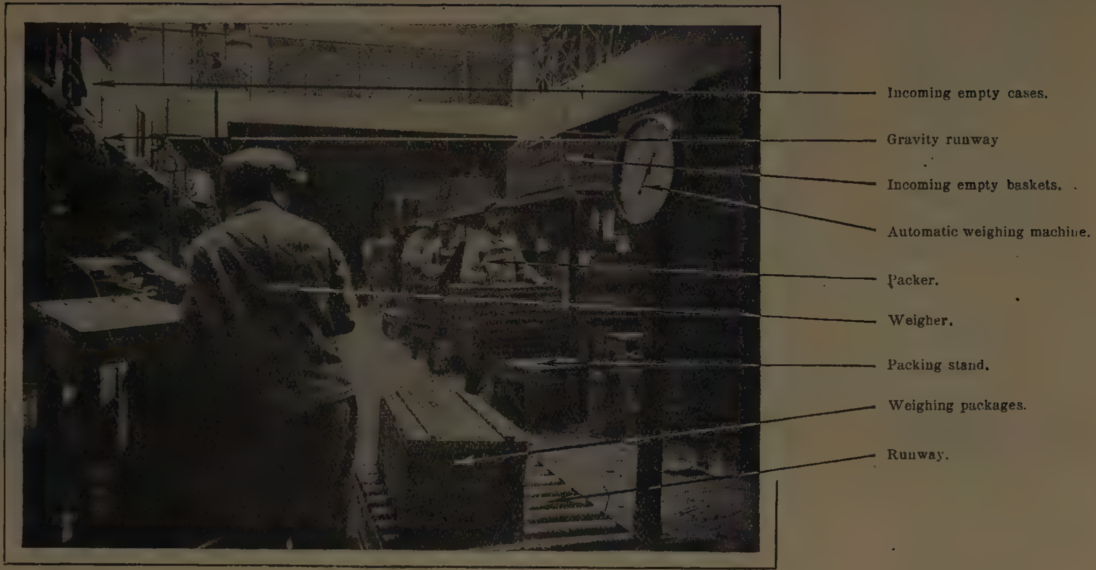


Fig. 6. — Packing.

chase prices has more than compensated for the cost of the additional staff.

The above are the general lines on which the stores of the technical departments have been organized; in detail, great care has been taken to reduce the cost of labour to a minimum; the fullest use has been made for the transport of goods, of wood platforms 0.70 m. × 0.90 m. (27 1/2 × 35 1/2 inches) on which these goods can be stacked, and which with their load can be moved about by elevating trucks; the parcels on the truck are taken to the first floor by a 2 000 kgr. (2-ton) lift of sufficient size to take two platforms; two chutes are used to send material from the first floor reserve stores to the distributing stores; a pneumatic tube is fitted by means of which the storesmen in the issuing stores send their demand notes for further supplies to the reserve stores; each holder when it arrives at its destination rings a bell which continues to ring until the storesman concerned attends to it.

As regards the general supervision, the precautions taken to ensure that orders are properly filled have already been described; as a general rule every operation in course of execution is represented by a printed form, the existence of which reminds the employee concerned that the work has still to be completed. In addition, every time that an employee completes a job, he has to write on the corresponding printed form in the place provided, the date (and often the time) and sign it. By this method it is possible to follow up mistakes and ascertain who is responsible.

Each employee is issued with an instruction book which gives in detail all the operations that may have to be carried out, as well as the list of all the printed forms that may pass through his hand and particulars of all entries he may have to make thereon.

In addition to the supervisory staff, to the purchasing department, and to the accounts section which are at Paris, the technical departments stores employ a staff of 70 :

The chief stores keeper;
The assistant chief stores keeper;
10 employees on the receiving side;
12 storesmen in the reserve stores.

In the issuing stores :

A head storesman;
An assistant head storesman;
6 storesmen (collectors);
2 storesmen (checkers).

On the despatch side :

11 packers;
4 employees.

In the offices :

A chief clerk;
An assistant chief clerk;
2 typists;
5 clerks on the ledger balances cards;
2 ledger balances checkers;
4 other employees;
6 employees of various kinds .

The duties covered by these 70 employees were, prior to the reorganization, carried out by a staff of 81, so that a saving has been made of 11, or 14 % of the former staff; the saving realized in reality, is much greater as the number of articles suppled by the Technical Departments Stores is now about 18 % greater than prior to the transfer.

[656 .254 (.44)]

Note on the organisation of duties in the Central Train Control Offices on the French Eastern Railway.

Figs. 1 to 5, pp. 823 to 826.

The Central Train Control Offices (C.T.C) of the Eastern Railway have to see that in their respective areas of the system the trains are worked in the best possible manner.

In the stations, or along the line, holding sidings or widened lines are provided into which trains which through lateness or failure to maintain speed interfere with faster trains following them, can be shunted; it is also possible at a junction where two trains are offered almost at the same time to give preference to one rather than the other, according to the speeds, stops to be made, and class of train.

Each minute lost in putting away into lay-by sidings trains which ought to make way for others can react upon the running of these latter and result in their being delayed an equal amount. If these latter trains have a long run to make (international trains, for example) if they have a fast timing, if they have during their whole journey to pass in this way a large number of other trains, the accumulation of minutes lost at each passing place can make them very much behind time, which, if the result of defective operating methods, would possibly become chronic.

It would certainly be so if the staff responsible for controlling the trains did not act quickly by making such alterations in the timing of the trains as would help matters. The same thing would occur if they were not kept constantly advised of the state of affairs on the line and if they had to wait until they had obtained information each time some decision had to be made.

The control points should therefore know very exactly at each moment, the position of the different trains running in their area and be able to give as quickly as possible to the interested control posts all useful information.

In order that they may be able to know accurately the position of the different trains, the controls should be advised at frequent intervals how these trains are running; this information will therefore be given them by the control posts of their area which will advise them of the situation of the trains in their immediate neighbourhood, by telephone. Conservely and for the same reasons of speed, the instruction from the C. T. C. to the control posts will also be sent by telephone.

The number of messages sent to the C. T. C. per unit of time is quite considerable and it is not sufficient merely to receive them to know the train position; they must be recorded in such a way, that they can be found at any instant and also be tabulated for comparison and deduction.

For this purpose the C. T. C. record them in the form of a train diagram.

In addition the movements of the train will be the better dealt with as the unity of control over the organization in greater; there will therefore be every interest in following the trains over the longest possible distance and simultaneously on different lines converging at common points.

The work of the C. T. C. includes on the one hand the recording of the information supplied by the Control Posts; on the other the comparison of this information so as to be able to make useful deductions therefrom and to issue the necessary orders. This work will be divided between two classes of employee, one of which is solely responsible for the actual recording of the information, the other solely responsible for the mental effort of making comparison and drawing conclusions therefrom. The first will be known as « Operator » and the second as « Controllers ». The work being divided in this way, several operators can divide amongst themselves the duty of recording the advices of an area too large to be dealt with by a single man; on the other hand, a single controller will be able to follow the development of the different diagrams kept by his operators because he will have been relieved of all manual work; the zone of action of a single individual thus will be largely increased to the benefit of unity of management.

It is however desirable to still further facilitate and coordinate the work both of the operators and controllers in order to get the best results from each one of them. The following methods have been used with this object on the Eastern Railway :

Operators.

The result of the above organization should be that the operators should receive information from the control posts and transcribe it in the form of diagrams. They should therefore have facilities by which to listen, speak, and write at the same time.

For listening, they have head phones. In addition the control posts are required to give their information in the briefest form so as to save the operators time (Train N°..... passed at...., Train N°....., arrived at...., left at....). Each operator sits between two glazed screens which whilst not robbing him of light isolate him as much as possible from the surrounding noise.

In order to be able to speak easily, the operator carries on the breast by means of a cloth band, a telephone mouthpiece which allows him to telephone in any position without any other movement than that of pressing a foot operated switch to allow the necessary current to pass; there may be several such switches if the operator has to work on several telephone lines; in this case, the switch on which he presses not only supplies the current needed but also isolates the line from the other lines, which thereby are available for the other operators or the controller to use.

The operators should be able to insert the numbers of the trains in different coloured inks according to the kind of train. They sit in front of a knee hole desk of the type shown in figure 2 which is arranged so that they can rest their arms on it. The diagram on which they mark all useful information rests on a slope and is fitted in addition to the usual holder diagram with a series of clips or cases in which the operator can

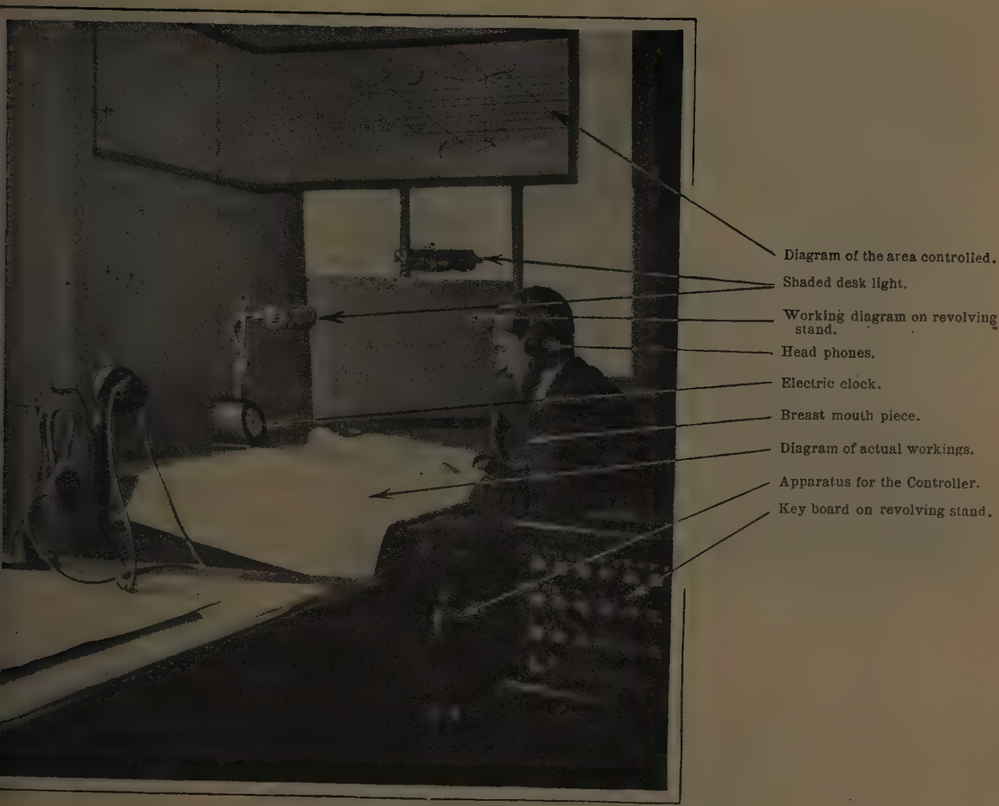


Fig. 1. — Operator's post.

insert all the information received and which could not be shown within the limits of the diagram. They each have as a rule as many pens as there are different coloured inks in use. When out of use each pen is left in an unspillable constant level ink well, the set of ink wells being carried on a bracket on the right hand part of the operator's desk; the latter is seated on a revolving chair so that he can turn to the most convenient position at any moment. At night a shaded lamp of the desk type suitably illuminates the diagram.

In addition the operator, as he receives as a rule the information hourly, ought to be in a position to verify the correctness of the times given him; to enable him to do this an electric clock is provided at the top of the desk in front of

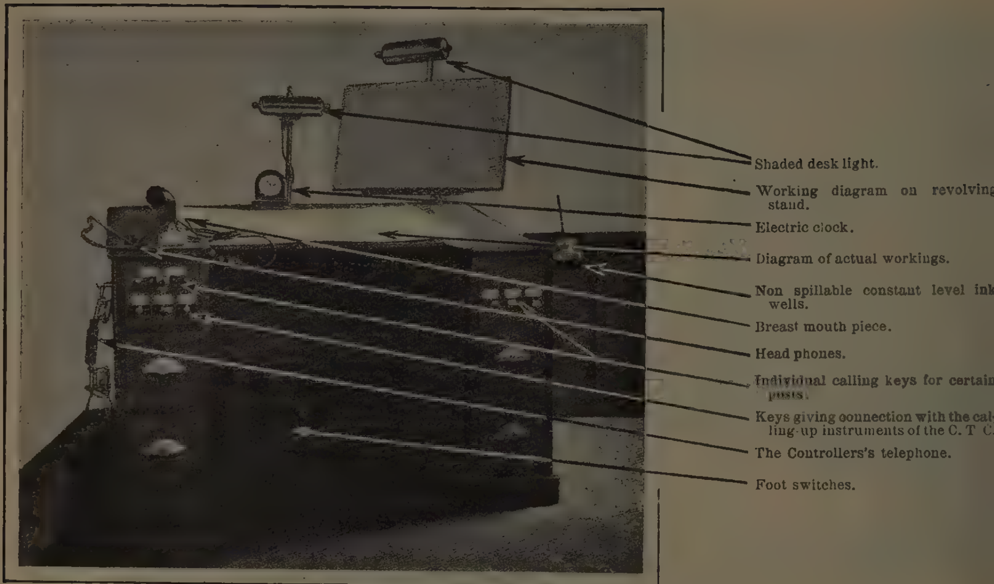


Fig. 2. — Operator's desk.

Fig. 3. — General view of a C. T. C.

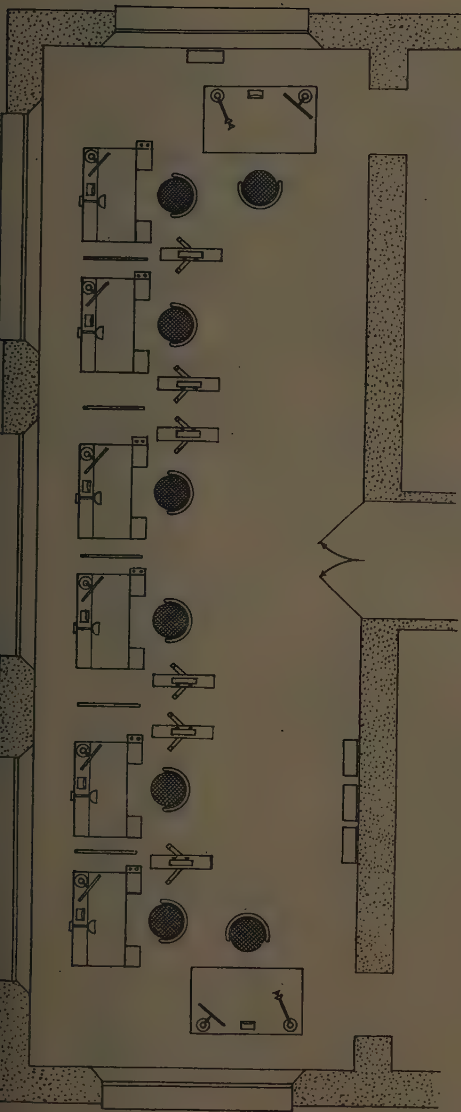


Fig. 4. — Plan of the Nancy Central Control Office.

him. He ought to be able to call up a control post in order to ask for any information not given or for any other purpose; for this reason he has at hand all the necessary instruments for calling up the different control posts with which he works. When as is the case of the apparatus used by the Eastern Railway, to call a signal box requires the use of both hands, one to turn the calling up key of the signal box in question and the other to put into circuit the calling up instruments of the central office, the keys making the connections are placed at the front of the desk conveniently to his left hand for example the calling up keys being collected together on an adjustable switchboard within reach of his right hand; this switchboard is so set that he can reach easily without having to move, and with the least hindrance, the right or left hand parts of this calling up switch board.

With this organization all the details of which are designed to facilitate the work of the operator both by lessening the movements he has to make during his work and by reducing the fatigue involved in each, it has been possible for a single operator to register the figure of 4 advices to the minute and 1246 in eight hours; to this figure should be added the requests for information from the control posts by the operator for transmission to the regulators; account must also be taken of the times during which the lines are in use by the controller for the transmission of their orders; taking these factors into account it can be said that the operators on the Eastern Railway succeed in receiving more than 5 communications to the minute and more than 200 to the hour.

As the intensity of traffic is not con-

Fig. 5.—Map of the Eastern Railway, indicating the train control areas in use, under construction, or proposed.

Translation of legend of map **(fig. 5) :**

Lines not worked under Control.

Lines worked under Control.

Lines which will shortly be under Control.

Control Post common to two Control areas with automatic switching equipment to give direct communication between two adjacent C. T. C.'s.

Control Post common to two Control areas not fitted with automatic switching equipment to give direct communication between two adjacent C. T. C.'s.

stant, the problem would not have been completely solved had it not been possible to vary in any one C. T. C. the number of the operators at different hours of the day; this can be arranged in the C. T. C. of the Eastern Railway thanks to the following arrangements.

By means of a panel with duplicated incoming lines, all the lines brought up to a C. T. C. can be put into connection with any one of the desks of the operators who have in front of their feet switches by which they switch in any one of the lines in question.

Then too, the key boards are moveable and can be taken off one stand straight away and placed on another or even piled one on the other, without any electrical connection having to be made; these connections are made automatically.

Through these various devices an operator's post can at any moment without delay, to the extent, of course, the intensity of traffic permits, be worked by any desired number of operators.

Controllers.

The controllers should be able to have as true as possible a picture of the traffic at any instant and to draw therefrom all useful conclusions.

To enable them to do this a passage is arranged behind the operators' desks so that the controller can walk in turn before each operator and see the diagram each is preparing. At the corner of each operator's desk there is a vertical stand on which is carried the working diagram [1], for the zone covered by each operator (this diagram is lighted up at night by an individual shaded light.) The controller can compare at a glance at any moment the actual position with the booked working. A pair of dividers enables him to transfere without calculation from one diagram to the other or from part to another of the same diagram the intervals of time (space between two trains or time of journey between two points) which are shown on the diagram by lengths and to check in this way accurately and quickly the first observations he made by eye. A special telephone instrument shunted off the operator's line can be used by the controller who can intervene while the operator is talking if he thinks necessary to ask for additional information or to give any orders he may wish to any control post.

Placed as a rule in face of (or at least close to) the operators' desks, a desk is provided for the controller. This desk on which are placed all documents he may have need of, allows him if he

(1) That is to say, the diagram showing all the trains as booked to run.

wishes to work standing up and so save any loss of time through sitting down and getting up again. If for any particular reason he has to sit down, a special stool is at his disposal. In any case, seated or standing, thanks to a duplicated set of switches flexibly connected together he can from this desk listen in on any particular telephone circuit connected to the control office and can give all necessary orders without moving. A special recording instrument, placed on the right hand side of the table enables him to keep trace of the orders given. In instances when he requires a particularly precise idea of the places in the zone of a certain control post, a diagram placed on the wall all round the C. T. C. office gives the exact layout of the whole area under his control. In addition a special calling up key enables him to get into immediate communication with his colleagues of the neighbouring C. T. C. by connection, at the boundary of the two areas with the lines belonging to each C. T. C., and gives him the means of obtaining information on the situation of the trains approaching his own area.

Thanks to these different devices all of which contribute to diminish both the physical and the mental effort required of the controller, a single controller is sufficient to control each of the C. T. C.'s on the Eastern Railway, the areas of operation consisting respectively of :

234 km. (145 miles) for the Châlons C. T. C.

364 km. (226 miles) for the Charleville C. T. C.

243 km. (151 miles) for the Longuyon C. T. C.

308 km. (191 miles) for the Nancy C. T. C.

213 km. (132 miles), 252 km. (157 miles) taking into account the four-track and six-track lines (1) for the Paris C. T. C. (fast lines).

9 km. (5 1/2 miles), 16 km. (10 miles) taking into account the four-track and six-track lines (1) for the Paris C. T. C. (slow lines).

263 km. (163 miles) for the Reims C. T. C.

308 km. (119 miles) for the Troyes C. T. C.

499 km. (310 miles) for the Vesoul C. T. C.

The difference in the extent of these areas is due to the topographical and administrative conditions, and also to the heavier or lighter traffic density in each, and to the longer or shorter distances between the control posts in operation. The differences in extent of the area under the Vesoul controller (499 km.) and under the Paris slow lines (16 km.) shows clearly the importance of these different factors. The whole difficulty of the work of the Paris (slow lines) controller lies in the multiplicity of the signal boxes, in the different paths available and in the special trains not shown in the booked workings. On the other hand the Vesoul C. T. C. which is the largest, as the Paris C. T. C. (fast lines) is the most important from the point of view of intensity of traffic, a single controller is able to follow, during his eight hours on duty, the work done on 7 000 km.-trains (4 350 train-miles) or a little more than 875 km.-trains (544 train-miles) the hour, nearly 15 km.-trains (9 train-miles) to the minute, or more than 10 trains at a time..

(1) The kilometrage of each section with four tracks being counted twice and sections with six tracks three times,

[62. (01 & 621. 392]

Results of trials and some notes on welded joints of profiled sections,

By H. DUSTIN,

ENGINEER, PROFESSOR AT THE UNIVERSITY OF BRUSSELS.

Figs. 1 to 7, pp. 831 to 834.

(*Revue Universelle des Mines.*)

The article submitted today is the logical sequence of two others:

1. The note published in December 1926 in the *Revue Universelle des mines.*
2. The paper I gave at the Amsterdam International Congress in September 1927.

It forms the practical expression of the results obtained during the systematic investigations we have carried out since 1925 on welded joints in the Materials Laboratory of the Free University of Brussels (2).

In order to make the following paper perfectly clear, it is advisable to be thoroughly conversant with the principal conclusions of the two above mentioned papers.

1925 to 1926 tests.

Before testing welded joints, it will be useful to obtain more precise knowledge upon the metal of the weld and on the effect the welding may have on the parts joined together. The information given towards the end of 1924 in the technical press was incomplete and frequently contradictory.

In this first series of tests we broke more than 300 test pieces and examined nearly 200 etched sections. We used welds made by the electric arc using covered electrodes, welding with bare wire by 1924-25 being already considered an out of date method.

Amongst the conclusions drawn from this first stage of work, should be kept in mind the following, remembering that they apply to welds of mild steel for constructional purpose, by means of mild steel rods :

1. The fact dominating all others is the capital importance of the selection of the electrode.
2. The metal deposited by an electrode of good quality behaves under static test like a good mild steel. The values got for Z, L, E, Z″, I″, and E″ are normal and, above all, *constant*.
3. It follows therefore that the dimensions of a welded joint can be calculated with confidence.
4. ....
5. The Charpy test is absolutely inadequate to decide whether the welds are brittle or not. It is essential to make tests as closely alike as possible to the conditions giving rise to stress in service.

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(1) Paper presented at the first meeting of the Belgian Association for the Testing of Materials, held on the 18 January 1928 at Brussels.

(2) This investigation was undertaken through the initiative of The ARCOS Electric Welding Co., at Brussels, which took an active part in collaboration.

6. The tests for fatigue being incomplete, ought to be repeated.

7. ....

8. The execution of the welds does not alter the metal welded or at least this is so in the case of mild steel. It acts as a normalising reheat, very localized and its effects are exactly the same as those of the well known heat treatment.

9. No useful purpose is served by annealing the welds.

* * *

The fatigue tests were again taken in hand in 1927, using improved technical methods and employing test pieces exactly like those recommended by Lloyds. They were carried out with great regularity and as a result we were able to draw the following conclusions:

Welds made with good quality coated electrodes have a limit of fatigue which is not very high but is well defined.

« Not very high » means that the values obtained are about 10 % lower than those given in the American tests for good cast steels. See *Bulletin of the University of Illinois* ».

« Well defined » means that there is an alternating stress which only requires to be reduced slightly — say by 1 kgr. per mm² (0.635 English ton per square inch) for the test pieces which previously broke regularly, to stand up practically indefinitely.

We give below as an example, the table of fatigue tests to which we subjected the electrode used in 1927 for our systematic investigation into simple joints (table I).

TABLE I.

Fatigue tests, 1927.

Electrode T used in the systematic tests.

Outside fiber stress.		Number of revolutions before fracture.	
Kilogrammes per square millim.	English tons per square inch.		
20	12.698	360 000	
20	12.698	160 800	
20	12 698	422 000	
18	11.429	668 000	
18	11.429	1 120 000	
18	11.429	715 000	
16	10.159	2 344 600	
16	10.159	2 344 600	
16	10.159	2 312 500	
16	10.159	8 243 000	6 test pieces unbroken after 10 000 000 to 15 000 000 revolutions.
15	9.524	∞	

Investigation into simple joints, 1926-1927.

No matter how varied the joints to be found in steel construction they can all be obtained by means of two elements only:

1. welding end to end;
2. tack-welding by building up in the angle formed by the pieces to be joined together.

The end to end, or butt welding has been completely studied in connection with boiler work; we know it is easy to obtain thereby the same strength as that of the pieces in question themselves. There only remains therefore the tack welds formed by building up.

When analysing the positions that such tack welds can occupy in a joint, it will be observed that in spite of the apparent varieties, these elements can only be in *two different positions of stress:*

a) The front position defined by figures 1 and 2;

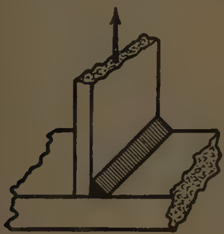

Fig. 1.

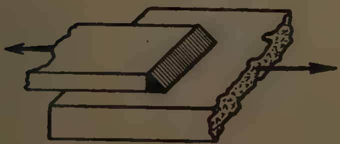

Fig. 2.

b) The side position defined by figure 3.

It is possible to imagine one intermediate position: *but impossible to imagine others.*

The strength of such front and side

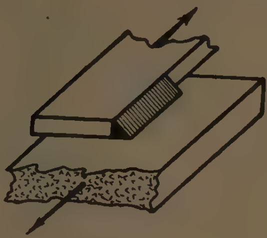

Fig. 3.

tack welds was investigated as early as 1922 especially by Humphreys in the U. S. A. and Hoehn in Switzerland.

The conclusions of these authors, based on tests, relatively few in number, are sometimes somewhat unexpected. They required proof.

This is what we have taken care to do by two methods:

1. By careful observation of the stress, of the deformation and of the failure of the welds;
2. By systematic tests carried out on a large number of welds — over 200 — under strictly controlled conditions.

Observed phenomena

The added metal at the weld has a section substantially triangular as shown in figure 4. Our tests showed that this profile without appreciable error can in fact be likened to the right angled triangle ABC.

The behaviour of the end and side welds under static and under dynamic stresses is quite different :

a) **End weld.** — The examination of the forms of fracture and the study of transparent models by polarised light on Cooker's methods, show that end welds behave as if they yielded to a simple

tensile stress uniformly distributed across the plane BH of the dangerous section (minimum section).

The breaking load of a front tack weld can therefore be calculated with ease: it is the product of the area BH by the

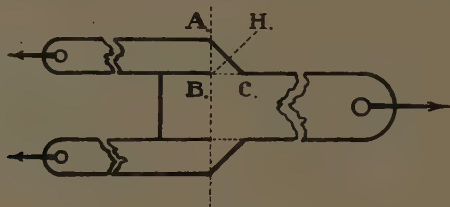

Fig. 4.

breaking load of the added metal. The strengths calculated in this way agree quite well with the results of tests.

The laws governing the strength of the front welds will therefore be those controlling the variations in the dimension BH.

b) **Side welds.** — By noting the form of fracture, the growth of the fracture in the added metal and the extensometer diagrams showing the passage to the elastic limit of the different parts of a joint made by side tack welding, one is led to conclude :

Everything takes place as if the side tack weld yielded to a shear stress in the plane BH of their dangerous section complicated by secondary stresses due to the ends.

The shearing stresses are unequally distributed in the plane BH and decrease

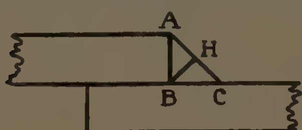

Fig. 5.

from the interior towards the exterior (from B to H) (1).

(1) Our assistant, the Engineer D. Rosenthal, studying the state of stress by purely analytical methods, arrived at the same conclusion.

The effect of the ends is small, is strictly localized and only appreciably influences the strength of the welds when the latter are really very short.

The laws governing the strength of the side welds therefore will be necessarily more complicated than in the case of end welds : they will be brought out by the systematically carried out tests.

c) **Breaking strength of welds.** — The end welds break — almost without extension — the breaking strength will therefore be low.

The side welds, on the contrary, yield considerably before fracture: considerable breaking strength is therefore to be expected. Experience shows that the work done at failure both under dynamic as under static loads, is considerable, and that in addition it increases very quickly with the length of the welds.

We have demonstrated, to illustrate this property, that when obtaining by trial and error, joints statically and dynamically equivalent to good riveted joints, the dimensions were very small.

d) **Factor causing variations of BH. « Natural » or « normal » profile of the welds.** — In the triangle of the weld ABC the dimension BH is a function of three factors.

α) the height AB or thickness of the strap.

β) the ratio $\frac{BC}{BA}$.

γ) the profile of the hypothenuse AC.

BH is necessarily proportional to AB. According as $BC = AB$, $BC < AB$, or $BC > AB$, we will designate the welds as « isosceles » « shortened » or « extended ». If $\frac{BC}{AB} = n$, we have $BH = AB \frac{n}{\sqrt{n^2+1}}$ a ratio which shows that for « shortened » welds BH decreases very quickly with n, whereas for the « extended » welds, it only increases slowly.

Experience has shown us that the « shortened » weld is dangerous and the « extended » weld hardly economical. The « isosceles » weld is the happy medium which one should endeavour to obtain.

We have studied the influence of the hypothenuse AC by milling the metal of the weld to shape.

When a workman makes a series of welds, as is generally the case in structural work, the profile of his weld tends very quickly towards a constant shape which we have designated the « natural or normal profile ».

This profile depends principally upon the electrode used, to some extent upon the thickness of the pieces to be joined together, but hardly at all upon the welder.

For the electrode used in our systematic tests, we have observed that their « normal » profile was an isosceles triangle with plane hypothenuse for medium thicknesses, slightly convex for the thinnest and slightly concave for the thickest. We also found that several electrodes of good quality from different sources of supply intended to make welds of good strength on mild steel, gave a normal profile almost identically the same. Similar observations have been recorded abroad.

The existence of the « normal profile » considerably simplifies the laws of the strength of the added metal part of every welded joint — and, as a consequence thereof, the calculation of the assembled part.

Systematic tests.

All these tests obviously ought to be made with the same electrode, if they are to be comparable one with the other.

What electrode ought to be selected?

If our results are to be directly applied in practical calculations, it would be necessary to adopt an electrode which truly represented the average of the electrodes (as to quality) used in constructional work in the countries where the greatest advance has been made in the art of welding, that is to say an electrode of a type which appears to have a fairly long future before it.

The electrode classified under the designation electrode T in our 1925-26 tests, meets these requirements very fully, and was selected for our systematic series of tests. It deposits a metal very closely analogous to the mild steel used for structural material (see *Revue Universelle des Mines* of the 1 december 1926).

We used test pieces of the design of figures 6 and 7 in order to avoid the effects of bending which might be produced in nonsymmetrical test pieces. To elucidate the influence of the various factors acting on the strength of the applied metal already mentioned, we have had to carry out more than 200 tests.

The length of the welds has been reduced to exact dimension by milling the ends, the profile being left untouched.

The welds were prepared by about a dozen different operators, several workmen often dealing with one series in order to determine the importance of the personal factor. They have been taken from welds of 5 to 15 mm. (3/16 to

5/8 inch) thickness so as to obtain results directly applicable to commercial sectional material. The detailed results, summarized in the tables attached to our report to the Amsterdam Congress show:

1. Confirmation of the above,
2. Remarkably good uniformity,
3. Almost entire absence of the personal factor in work carried out in a regular manner. From the point of view of the calculation of built up structural work, the ultimate end of our investigation, they have enabled us to formulate precise rules of great simplicity.

They may be set out as follows:

1. ....
2. The added metal of the welds shall be made with electrodes which, in addition to the usual qualities required of a good electrode, shall have the following characteristics:

a) the metal deposited shall be mild steel having a breaking strength of 38-40 kgr. per mm² (24.13 to 25.40 English tons per square inch) with 15-20 % elongation;

b) the « natural » or « normal » profile of the deposited metal shall be level or sighthly convex, but never clearly concave.

3. That being so, one can count with certainty for the front end welds on a breaking strength of 2.6 t. per cm² (16.51 English tons per square inch) of the piece directly in contact with the weld.

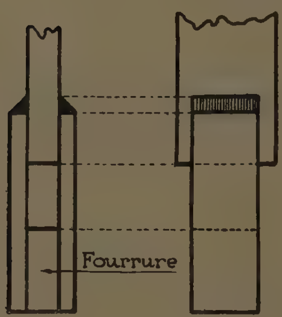

Fig. 6.

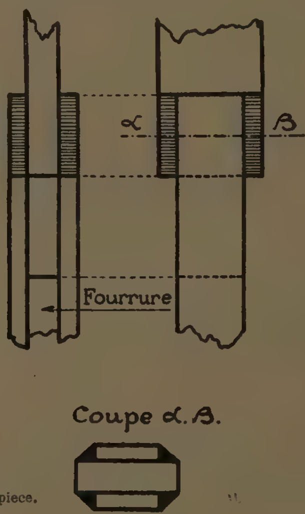

Fig. 7.

Explanation of French terms (figs. 6 and 7):
Coupe = Section through. — Fourrure = Distance piece.

For the mild steel used in ordinary constructional materials with a breaking strength in the neighbourhood of 40 kgr. per mm² (25.40 English tons per sq. in.) we can say that an end weld is equivalent in strength to 65 % or 2/3 of the section directly in contact with it.

4. That being the case, we can be sure of getting for the side welds a breaking strength of from 2 to 1.6 tonnes per cm²

(12.70 to 10.16 English tons per square inch) of the section of the part directly in contact with the weld according to the thickness of the latter.

For the ordinary constructional mild steel with a breaking strength of about 40 kgr. per mm² (25.40 English tons per square inch) we can state that a lateral weld is equal to a fraction (50 to 40 %) of the strength of the section of metal directly in contact with it.

5. When the strength under static loads is considered as the more important, the end welds should be built up first of all as being the most useful. When on the contrary, the strength under dynamic stresses is the more important, the preference should be given to the side welds.

Application to rolled sections.

The application to commercial rolled sections of the rules we have laid down for simple joints, will give us information on their real practical value.

I am now going to describe to you the results of our tests on joints of rolled sections. These tests were carried out during the second half of 1927.

Preliminary question. — When two rolled sections having each a strength R, are rivetted together, the whole has only a strength $R' < R$.

The reduction comes from two causes: the loss of section due to the rivet holes — the frequently unavoidable excentricity of the joint.

With welding, the first cause of weakness disappears: the second remains, at least in the case of joints with strap plates or gusset plates the more frequently used at the present time.

It is advisable this loss should be determined experimentally, as positive knowledge about it is lacking; it is important the work should be done as it is not economical to make joints much stronger than the parts themselves in the position they occupy in the structure.

For this object we selected a series of ordinary rolled sections (∟, ⊤, ⊔) and proceeded as follows:

We took lengths of about 1 m. (39 3/8 inches) and joined them together in pairs by welding them on a heavy gusset plate to make test pieces of the type shown in figures 2 and 3. The symmetry of these test pieces should avoid any bending stresses. The welds were purposely given an excess volume.

We welded the same rolled sections end on to mild steel cylinders by means of end welds surrounding the whole section, a joint much stronger than the rolled section.

Finally, from some sections, especially the largest, the size of which exceeded that of the cylindrical pieces we had at hand, we cut a series of bands.

We then pulled the whole lot on our 100-ton Amsler testing machine.

The results of these tests, twenty eight in number, are grouped together in table II.

They show that the *strength of rolled sections welded on to gusset plates is remarkably well utilized.* For regular sections such as the ⊔ and ⊤, the effect of excentricity is practically negligeable; for the ∟ sections the loss of strength is less than 10 %.

The bending of the broken sections reveals however, that the interior fibers lengthen more than the outside fibres.

This has the practical consequence that the welded joints ought to be calculated for a strength equal to that of the full cross area of the rolled sections.

Systematic tests. — In these tests we gave the welds a calculated strength of 15 % less than that of the sections joined together, so as to be sure of getting the fracture through the joint.

We employed the same electrode as for our tests on simple joints. We therefore welded the rolled sections together by means of rods of very similar metal to that of the sections.

Our tests have shown that from the point of view of economy it was generally of little value to make the weld stronger, as for example one giving a breaking strength of 50 kgr. per mm² (31.74 English tons per square inch). From the point of view of safety this could even be dangerous. We ought to remember that commercial rolled sections have only a medium strength as regards longitudinal shear. At the moment of fracture a side weld with T electrode stresses the adjacent metal of the rolled section almost to breaking point: a weld of equal total strength, but slightly shorter (by 15 % is enough) regularly results in the fracture by slip in the metal of the rolled section.

TABLE II.

└, ⊤ and ⊔ rolled sections

Breaking strength in kgr. per mm² (English tons per square inch).
(July-August 1927).

SECTION.		2 pieces welded to the gusset plate.		Welded to round bars.		Strips cut from the section.		
In millimetres (in inches).		kgr./mm²	tons/sq.in.	kgr./mm²	tons/sq.in.	kgr./mm²	tons/sq.in.	
└ 30/30/4 (1.18/1.18/0.157)	1	38.0	24.13	40.3	25.59	...	...	
	2	36.4	23.11	40.6	25 78	...	...	
└ 50/50/5.1 (1 97/1.97/0.201)	1	39.0	24.76	40.9	25.97	...	...	
	2	35.2	22.35	40.9	25.97	...	...	Point of weakness : yielding of └
└ 70/70/7.5 (2.76/2.76/0.295)	1	40.0	25.40	...	...	42.2	26.80	
	2	39.25	24.92	...	...	42.6	27 05	
⊥ 53/28/6.6 (2.09/1.10/0.260)	1	38.1	24.19	38.4	24.38	40.0	25.40	
	2	37.6	23 88	37.8	24.00	37.9	24 07	
⊥ 50/50/6.6 (1.97/1.97/0.260)	1	37.2	23.62	37.8	24.00	38.1	24.19	
	2	37.4	23.75	37.8	24.00	38.3	24.32	
⊔ 80/44 standard (3.15/1.73)	1	37.3	23.69	...	...	37.4	23.75	
	2	37.3	23 69	...	...	36.8	23.37	

Moreover the reasons for which we adopted this electrode for our tests on simple joints also apply here.

The rules for joints we have enumerated show that the jointing of rolled sections on a gusset plate having a strength of $100 - 15 = 85$ % of that of the rolled sections can be obtained by:

a) side welds of proper thickness and length;

b) end welds combined with side welds: it could not be got by front welding alone as this latter could not be given either the height or the length needed.

The two methods *a*) and *b*) have been utilized.

The rolled sections have been joined up in pairs on a heavy plate forming a gusset plate as in the previous tests and for the same reasons.

With dissymmetrical sections such as angles, we used side welds of unequal sections, but of equal length so as to get the centre of gravity of the section of the whole weld to coincide with that of the pair of rolled sections.

In the case of the simple joints, the shape of the test piece itself delimits very closely the dimensions BA and BC of the added metal of the weld. How are we to deal with the sections so that the dimensions of the metal of the weld may be accurately known, and as a consequence their strength may be calculated accurately ?

To deposit metal following an exact line is awkward and is a method of working which is not used in practice. In practice the workman deposits one, two or three layers of metal one above the other by means of an electrode of a size suitably chosen with a view to obtain about the total volume of metal that he considers necessary.

In working, with a No. 8 wire electrode, we have a check that the added metal deposited in the angle between the two pieces and built up of one two and three superimposed layers, reproduces fairly correctly the natural or normal profile of the welds of 5, 10 and 15 mm. (3/16, 3/8 and 5/8 inch) used in our tests on simple joints.

We have adopted the above simple and accurate method of operation in our tests on rolled sections.

We prepared, as mentioned above, about thirty joints from L, T, and ⊐ sections which we then tested.

TABLE III.

L, T and ⊔ rolled sections, riveted to a gusset plate.

Side weld only.

Dimensions of the welds. — Comparisons between the calculated and observed values of the breaking stresses. — August 1927.

SECTION.		Nº 8 Electrode.		Breaking load.				
		Length of the weld.	Number of layers.	Calculated.		Observed.		
In millimetres (in inches).		In millimetres (in inches).		Kgr./mm².	Engl.tons/sq. in.	Kgr./mm².	Engl.tons/sq. in.	
L 30/30/4 (1.18/1.18/0.157)	1	30 (1 3/16)	2 + 1	15.2	9.65	15.3	9.72	
	2					15.3	9.72	
L 50/50/5.5 (1.97/1.97/0.22)	1	60 (2 3/8)	3 + 1	38.4	24.38	38.2	24.26	
	2					38.3	24.32	
L 70/70/7.5 (2.76/2.76/0.29)	1	120 (4 3/4)	3 + 1	80.0	50.80	80.5	51.12	
	2					80.3	50.99	
⊥ 53/28/6 (2.09/1.10/0.236)	1	90 (3 1/2)	1 + 1	36.0	22.86	30.3	19.24	Point of weakness in a T.
	2					30.3	19.24	
⊥ 50/50/6 (1.97/1.97/0.236)	1	130 (5 1/8)	1 + 1	50.4	32.00	45.0	28.58	
	2					45.0	28.58	
⊔ 80/44 standard (3.15/1.73)	1	120 (4 3/4)	2 + 2	88.0	55.88	86.3	54.80	
	2					86.5	54.93	
	3	90 (3 1/2)	3 + 3	...	...	87.5	55 56	

TABLE IV.

L, T and ⊔ sections welded to the gusset plates.

End and side welds.

Dimensions of the welds. — The calculated and observed values of the stresses.

SECTION, in millimetres (in inches).		No. 8 Electrode. End weld. — Number of welds.	No. 8 Electrode. Side weld. — Length and number of welds.	Breaking load. Calculated. Kgr./mm².	Breaking load. Calculated. Engl. ton/sq. in.	Breaking load. Observed. Kgr./mm².	Breaking load. Observed. Engl. tons/sq. in.	
			mm. (inch).					
L 30/30/4 (1.18/1.18/0.157)	1 2	1	20 2+1 (3/4)	17.0	10.8	17.6 ...	11 18 ...	Broke in the L
L 50/50/5.5 (1.97/1.97/0.22)	1 2 3 4	1	30 3+1 (1 3/16)	33.8	21.46	31.4 30.7 31.7 31.9	19.94 19.50 29.13 20.26	
L 70/70/7.5 (2.76/2.76/0.295)	1 2	1	60 3+1 (2 3/8)	65.4	41.53	63.5 63	40.32 40.00	
⊥ 52/28/6 (2.05/1.10/0.236)	1 2 3 4	1	35 1+1 (1 3/8)	30.4	19.3	24.8 24.5 26.1 25.6	15.75 15.56 16.57 16.26	
⊥ 50/50/5 (1.97/1.97/0.197)	1 2	1	50 1+1 (2)	33.0	20.96	26 25	16.51 15.88	Fig. I.
⊔ 48×4 / 85×5 (1.89×0.159 / 3.35×0.197)	1 2	1	65 2+2 (2 9/16)	70.0	44.45	67.5 69	42 86 43 82	
⊥ 50/50/5.5	1	Fig. I.	55 1+1 (2 3/16)	41.5	26 35	39.5	25 08	
(1.97/1.97/0.22)	2	Fig. II.	50 1+1 (2)	30.0	19.05	28.6	18.16	Fig. II.

The results of these tests are condensed in the two tables Nos. III and IV.

In the former, the joint was made by means of side welds exclusively. In the second, end welds were used, completed to get the desired strength by side welds.

Joints by side welds alone. — Table III shows a remarkable agreement between the calculated strength and the observed strength for the L's and ⊔'s; for the T's there was an appreciable difference: the actual strength is less than the calculated. Why?

The welds would give the calculated strength if they were stressed almost uniformly over their whole length; but the shape of the section is such that the inside end of the welds is definitely overstrained. The practical remedy consists in slightly lengthening the weld.

Combined end and side welds. — In this case we find everywhere an actual strength lower than the calculated strength. But the difference is very variable: insignificant for the ⊔'s, as much as 10 % for small L's, and up to 20 % for T's.

Why this difference? How is it to be overcome?

The cause of weakness in this case is twofold: besides an unfavorable distribution of stresses (especially in T's.) there is the union in one joint of such different connections as an end weld and a side weld.

If we follow the mode of fracture of these joints we will note that the tearing apart always starts in the end weld which is however the strongest element in the whole unit. Why?

The end weld cannot yield appreciably before breaking and in the elastic range its deformation is inappreciable; on the other hand, the side welds have great ductility, and undergo before failing such deformation as to strike the least attentive observer and give elastic elongations which can be recorded on quite ordinary instruments.

From this we get the result that when a joint with both types of weld is progressively loaded, the stressing of the welds first of all agrees with the calculations, and then differs from it as the load increases: the end welds have to support an increasing load and relieve the side welds in proportion.

The practical remedy evidently lies in strengthening the welds. But which should be strengthened up?

It is a question of kind. On small angles there is generally no space available for adding an end weld, and therefore the side welds must be lengthened a little. With the T's and larger angles the end reinforcement shown in No. II sketch of the table, can be made: finally when there is some little space available on the gusset plate, the end welds of the T's can be reinforced as shown in No. I sketch of the table.

Many other solutions can be adopted: the above are given as examples.

It will therefore always be possible by very simple methods to give our joints of whatever kind they be, the exact strength we had fixed upon beforehand.

If we examine the dimensions of the bands of added metal of the welds given in the tables, and if we remember that their strength represents about 85 % of that corresponding to the full sectional area of the rolled sections, we cannot fail to be struck by their smallness.

Joints equal in strength to that of the sections themselves would be very little larger: welding produces remarkably neat and compact connections in constructional work when compared with riveted connections (1).

To complete the investigation into welded joints, it is necessary to study their behaviour under dynamic stresses and under repeated stresses — and also to examine the influence of the weld on the secondary stresses at the connections and upon the allowable degree that bars in compression can be taken as being rigidly held.

This study has been made: it leads us outside the field of the testing of materials into that of construction. It has led us to very interesting conclusions often in entire opposition to the sentimental or ready made opinions which are the most widely held.

Let us however sum them up briefly: in this way, the present article will give some idea of the cycle of investigations on welded joints organized in our laboratories.

Joints calculated for *static stresses* as has been said already, will have usually a dynamic strength *greater than* that of the different parts assembled together.

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(1) The tendency at the present time in welding structural work is to suppress completely the gusset plates and all intermediate pieces in the joints.

Vis à vis repeated stresses, their strength will be frequently equal or superior to that of the parts assembled: in the contrary event — not frequent — the additional reinforcement to be provided will be slight.

Bars in compression when welded should be calculated as if their ends were pivoted and using their actual length. No account at all can be taken of any building in at the connections: exactly as in the case of riveted joints.

The secondary stresses in the neighbourhood of the connections are due to two causes: deformation of the trellis work and the excentricity of the parts in relation to the theoretical connections. Welded joints unite best factors for reducing (according to the most recent work on the subject) the stresses due to the first cause : the excentricity of the loading is less than in the case of riveted connections and can be completely avoided in many cases.

January 1928.

CURRENT PRACTICE.

656 .259 (.42)]

Periscopes on electric trains, Southern Railway (Great Britain).

Fig. 1, p. 841.

The projection of the guards' side observatories on a certain group of 3-coach electric trains precluded the stock from circulating over the whole of the electrified lines.

To obviate this difficulty the side observatories have been removed and periscopes provided in their stead to enable guards to sight signals.

The periscope, illustrated in the ac-

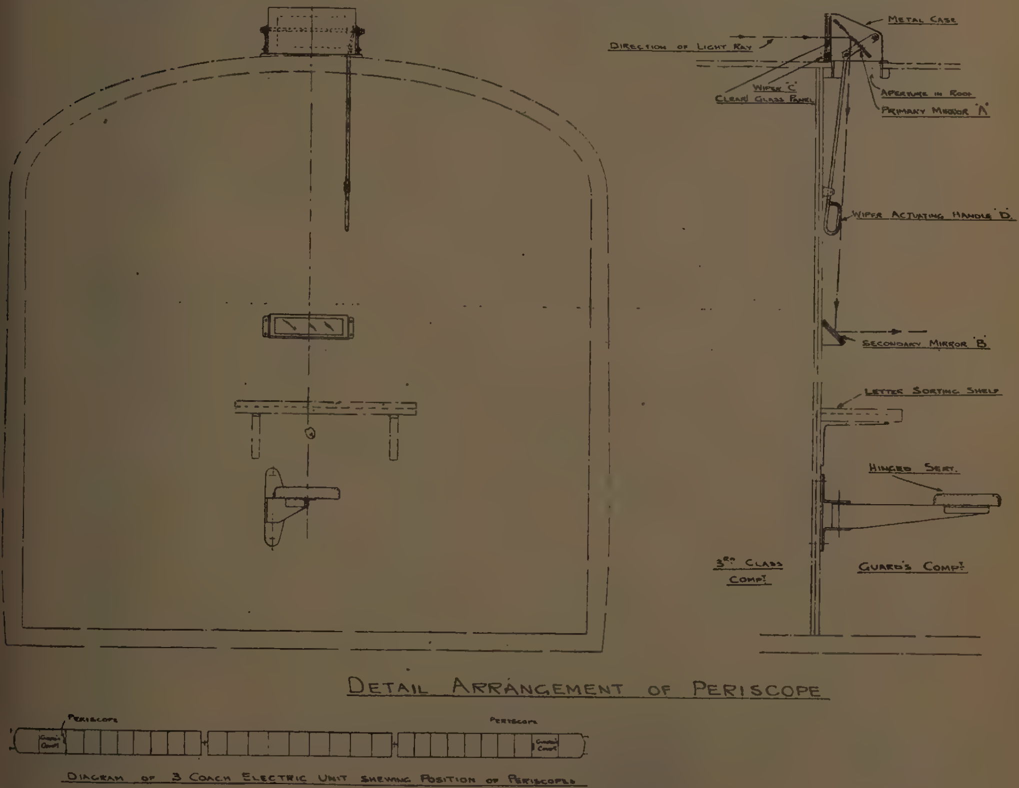

Fig. 1.

companying drawing (fig. 1), consists essentially of two mirrors. The primary mirror « A » situated outside the roof of the guards' compartment, reflects objects within its field of view to a secondary mirror « B » fitted inside the guard's van which diverts the reflected image to the eye of the observer.

The primary mirror is enclosed in a metal case fitted with a clear glass panel to protect the mirror from the weather, and in addition serves to cover the aperture in the roof through which rays of light pass.

An india rubber wiper « C » is attached to the case for cleaning the outside of the glass panel, and is operated by raising or lowering the actuating handle « D ».

A hinged seat, similar in design to that provided for the motormen, is fitted below the secondary mirror to facilitate observation.

In the case of these trains the guard travels in the rear of the electric unit which accounts for the periscopes functioning in one direction of the train only.

NEW BOOKS AND PUBLICATIONS

[385. (02 & 656. (02]

LAMALLE (Ulysse), Civil Engineer, Director of Operation, Belgian National Railway Company. — **Cours d'exploitation de chemins de fer. Tome I. Exploitation commerciale, 2e Edition, (Railway Operating Course. Vol. 1, Commercial Operating, 2nd Edition).** — One volume (11 by 8 5/8 inches) of 196 pages with 79 figures and numerous tables. — Louvain, Librairie Universitaire, 10, rue de la Monnaie ; Paris, Dunod, éditeur, 92, rue Bonaparte. (Price : 45 francs).

On a railway system, the Operating is the most important department. It is responsible for ensuring that the undertaking fulfills the object for which it was created; to transport passengers and goods with the necessary speed and regularity and at satisfactory rates commercially. It has to obtain precise information as to the requirements of its users, even to create such demands, and to take the best steps possible to meet them.

Other services have to provide the means of doing the work, such as the track, the stations, the stock. This equipment should be designed in accordance with the requirements laid down by the service responsible for the organization of the trains.

In addition, besides the actual transportation business, the output or capacity of the railways has to be watched and improved. In this field the Operating Department has above all to study the rates in order to adjust them to the prevailing conditions whilst closely following their effect on the traffic, on the commercial activity of the country, and upon the prosperity of the railway system. These matters as a whole constitute the functions of what is known as the Commercial Operating Department.

Mr. Lamalle by his previous articles as by his professional duties which oblige him day by day to consider in detail the subject is fully qualified to deal with it. Undoubtedly the title « Course of Commercial Operating » he has given to his book is justified by the order and the method he has used in his treatment of the subject which give it a marked instructional character; the fullness of description and the wealth of information would have well justified a less modest title.

The book is divided into six chapters.

Chapter I deals with legislation applicable to the railways. The author states the reasons justifying special legislation and gives an analysis of Belgian legislation on the subject. This latter is completed by the International Conventions on the transport of passengers and goods (CIM and CIV) which have the force of law in the countries concerned. The author gives the history, defines their nature and extent, and shows the resultant advantages.

Rates are dealt with in Chapter II. Mr. Lamalle in turn gives particulars of the scale of charges, shows the need for it, and indicates the conditions under which it is applicable. He then discusses the bases on which a scientific system of rates can be built up and after examining the various ways of building up the charges, he explains the points of similarity in the various systems. He makes use of the occasion to give particulars of the Belgian system known as such, the remarkable elasticity of which enables it to be adapted to the most varying circumstances and by the diversity of its rates to lead to a better use of the

rolling stock. The economy of the special rates which play such an important role and in dealing with which the operator can exercise such skill and ingenuity is of the greatest importance. Finally the author shows how the rates applicable to journeys involving several railway systems facilitate international working, regulate competition between the railways, and stablise the movement of traffic.

Passenger traffic rates offer many remarkable examples of the general ideas developed in chapter II, and in particular, the special rates granted to certain kinds of passengers, and the differential and reduced rates known as season ticket rates. Amongst these latter, workmens' season tickets have been much more widely used in Belgium and exercise a considerable economic and social influence.

The first three chapters can be considered as the foundation of the work, which is the study of the means followed by the railway to perfect its working in order to be able to carry out its task under satisfactory conditions as regards its customers whilst assuring its own prosperity.

The last three chapters are devoted to an examination as to whether these objectives are attained.

Chapter IV is entitled : « Measurement of the utility of railways » and contains the most interesting pages of the book. In it we see the economist exploring by means of diagrams the whole field of operation of the railway and showing how, by the multiplication of rates it is possible to attain the extreme values of the coefficients of utility for the public and of efficiency of the machine.

The calculation of the cost of operation has been the subject of many investigations, especially in America. The great difficulty consists in distributing correctly certain expenditures. It is also necessary to distinguish between the total cost or the general average cost price and the partial cost of any transport. The distinction is especially important when it is desired to establish the relation between the cost price and the rates. The different points are clearly set out in chapter V where the discussion is supported by actual information taken from the operating statistics of the Belgian system.

How should the operating results be issued ? How ought they to be examined and what conclusion should be drawn from them ? Mr. Lamalle deals with these points in the last chapter. He there shows what are the most useful statistics to prepare, and as they are necessarily highly developed, he calls attention to the simplification obtained by using automatic statistical machines now being increasingly employed and which are in use on the Belgian railways.

This analysis, naturally incomplete, of a work which takes a worthy place in railway literature, will incite, we hope, both those it directly interests by dealing with the questions coming into the field of their daily activity and also those occupied in other duties to read it and to study it. To these latter it will help to give the best and most general views on the objects and of the organization of the great undertaking in which they collaborate.

E. M.

[625. 14 (.43)]

SALLER (Heinrich), Dr. Engineer, Director on the German Railways, attached to the Ratisbonne Headquarters. — **Der Eisenbahnoberbau im Deutschen Reich**. Ein handbuch für Lernende und Lehrer des Eisenbahnwesens. (**The permanent way on the German Railways**. Handbook for railway students and teachers). One volume (Din A5), 344 pages with 143 figures and tables. — 1928, Berlin W. 8, Verlag der Verkehrswissenschaftlichen Lehrmittelgesellschaft m. b. H. bei der Deutschen Reichsbahn. — Price : 15 Rm.

Dr. Saller's handbook deals especially with the methods and processes used to obtain the general and particular features of the German permanent way. He includes none the less much information and numerous lines of thought which may find application on all railways. From the technical point of view, the author's work can be unreservedly praised, as he has made the book of use to all permanent way engineers: the chief amongst them, as the lower grades, will find thoroughly sound short reviews of the most recent investigations as well as interesting accounts of older methods.

Attention can be called in particular throughout the book to the chapters dealing with the details of the track, such as the rails and sleepers: as regards these latter, the author notes that in 1924 there were on the German railways 46 000 km. (28 580 miles) of track laid on wood sleepers, and 29 000 km. (18 020 miles) on steel sleepers. The proportion, therefore, was as 8 to 5 in favour of wood sleepers. It is difficult to solve by definite arguments the question of the preference to be given to any one sort of sleeper. If from a purely technical point of view, the wood sleeper appears to have some advantages, it must be admitted that the use of steel sleepers would form a valuable outlet for the products of the steel makers.

The chapter on joints is well presented, all modern types being subjected to very close criticism.

Dr. Saller prefers the over hanging joint, this type alone having the qualities of elasticity and of continuity needed.

The author has not failed to devote a special chapter to the welding of rails. He points out in this connection, that if all the railways of the world were joined end to end the total expansion would be about 300 km. (about 190 miles) or about the distance between Berlin and Hambourg. The expansion of rails cannot be ignored therefore. It must be taken into account, either by absorbing the interior stresses it sets up, or by giving it free play. Tests on the welding of rails continue to be carried out on the German railways, but with quite understandable caution.

The author describes at some length the latest German pattern of track, mentioning in particular the new sole plates with projecting ribs for use on wood sleepers. This plate is fastened by coach screws directly to the sleeper. The rail is secured to the sole plate by clips tightened down by bolts held between the projecting ribs. In this way, independence has been achieved between the two sets of fastenings—sole plate to sleeper, and rail to sole plate.

At the present time it is considered of great importance that the fastening of the sole plate to the sleeper should be relieved of the forces acting directly on the rail. In the case of the steel sleeper, the problem is rather more difficult to solve. The solution will be greatly facilitated by welding the sole plate to the sleeper.

Dr. Saller who has specialized in the study of the dynamic actions of shocks on railway tracks gives a brief summary of the static calculation of the track. According to locality, the permanent way design is checked either in accord-

ance with Winkler's simplified method, or following the results obtained by Zimmermann. The maximum allowable stresses are 1 000/1 700 kgr. per cm² (14 220 to 24 170 lb. per square inch) for the rails, 900/2 200 kgr. per cm² (12 800 to 31 300 lb. per square inch) for steel sleepers, and 40/60 kgr. per cm² (570 to 850 lb. per square inch) for wood sleepers, the unit pressure on the ballast not exceeding 1.5 to 2.5 kgr. per cm² (21 to 36 lb. per square inch).

The coefficient of ballast is taken as equal to 8 (light track) or 15 (heavy track).

The last chapters of the manual and not the least interesting, to the professional engineer, deal with the construction and maintenance of railways, a large part being devoted to the mechanical equipment, a subject of great importance at the present time. When preparing the formation, the author calls attention to the importance of a recent method by which the lower layer of ballast is first of all compressed by a preliminary ramming.

In passing, we would call attention to the application shown by the author of the use of reinforced concrete frames under the joint sleepers (Meierhofer system).

This idea is not new: it dates from the invention of the Vagneux reinforced concrete sleepers. The application that Engineer made of such joint frames at that time was moreover more thorough as well as more scientific. The Vagneux joint frame was formed by the sleepers themselves, and resulted in an especially efficacious reinforcement of the joint. Since that period, the Vagneux sleepers have been used on a more extensive scale and probably represent the best solution of the reinforced concrete sleeper question so far devised.

Dr. Saller also calls attention in his article on tool equipment, to the increasing importance of mechanical tamping tools in track maintenance work.

When reviewing the various causes of the deterioration of the track, the author mentions the corrugated wear of rails and describes how it shows itself.

It is useful to note with the author that this wear has only become of real importance since the flexibility of the track has been reduced by the introduction of heavy rails and the strengthening of the equipment of the track in general.

Finally, in ending this short summary of Dr. Saller's most interesting manual, we strongly advise all permanent way Engineers to read it: they will undoubtedly find information and ideas of value in it.

R. D.

[625 .4 (.42) & 656 .2 (.42)]

THOMAS (J. P.), M. I. E. E., M. Inst. T., Superintendent of operating on the London Electric Railways — **Handling London's Underground traffic.** — One volume (8 1/4 × 5 7/8 inches) of 237 pages with many illustrations. — 1929, London, Underground Railways, 55 Broadway, Westminster, S. W. 1. — Price 7 sh. 6 d. net.

The greater part of the Underground railways in London is operated by a combine; the « London Underground Group » which also includes the « London General Omnibus Company ». It is the largest undertaking dealing with urban transport in the world. It represents a capital of no less than £ 65 766 288 entirely subscribed by the public without any participation by the State or City. The railways represent about 82 % of this total. The railway system which is all electrified consists of 128 miles of double track lines,

including those sections of other companies' lines run over by trains belonging to the combine.

This railway system is very complicated from an operating point of view as it was built as separate lines by different companies without any thought of the possibility of cooperation with other companies or of different means of transport. The management had to take various measures to make good this state of affairs, and its efforts have enabled it to cope with the working of a considerable traffic which is represented by a total mileage of 80 000 000 vehicle-miles per annum, and the carrying of 1 020 000 passengers per day.

The working of this traffic means a very high density of traffic especially in certain sections. It amounts to 40 trains per hour over each line between Mansion House and South Kensington, and Kensington station has to handle 108 trains per hour at certain moments of the day.

To deal with a service of this kind with almost perfect regularity necessitates a highly developed organization. A book in which it is described by an author who largely contributed to making it so efficient and who directs it, cannot but be of the greatest interest.

Chapter I describes the general organization of the Operating Department.

Chapter II describes the way the staff is recruited, trained and administrated.

In chapter III the author gives particulars of the methods used to adapt the workings to traffic requirements, and to supervise the regular running of the trains.

Chapter IV shows how the working time tables are prepared, and gives particulars of the way in which the turns of duty of the staff are arranged.

Chapter V treats of the operation of the trains; it includes the working of trains over the lines, the signalling arrangements, and the lay out of the terminal stations.

Chapter VI is given over to the train control which supervises the train movements in order to meet any emergency which might upset the service.

Chapter VII deals with the signalling. In it will be found for example the manner in which every defect occuring is carefully recorded and analysed.

Chapter VIII describes the breakdown methods used under various circumstances; telephone lines enabling the driver to speak to the sub-station, « dead man's handle » for the driver, clocks showing the time preceeding train is ahead, telephone between the driver and guard, safety appliances in the lifts and moving stairways, etc.

In chapter IX particulars are given of the difficulties the management of the « Underground » have to meet in the event of exceptional rushes of traffic on special occasions.

Chapters X and XI give descriptions of the most interesting types of rolling stock, from the oldest, a steam train of the « District Railway » to the most modern electric carriages. These latter have supplementary side doors at the centre of the vehicle. These doors worked by compressed air, enable passengers to leave more quickly, one guard being able to deal with a train of seven coaches.

Chapter XII describes the steps taken to accelerate and cheapen the cost of issuing tickets; the introduction of the « scheme » ticket, a ticket for several destinations; the use of mechanical devices : automatic ticket issuing machines, printing and issuing machines, change machines, etc.

Chapter XIII gives particulars of up-to-date layouts of stations; all designed to facilitate the movements of passengers to the trains and to the exits from the stations.

Chapter XIV contains a short review of the considerable development of the service of the Underground railways of London. It shows the influence of the

construction of extensions on the prosperity of whole areas on the outskirts of Greater London.

The book is full of photogravure illustrations showing the most charasteristic documents used, the equipment, and the most interesting apparatus. It is very finely printed, which adds to the pleasure of reading a most interesting work.

E. M.

MONTHLY BIBLIOGRAPHY OF RAILWAYS [1]

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General secretary of the Permanent Commission of the International Railway Congress Association.

(JANUARY 1929)

[016 .385 (02]

I. — BOOKS.

In French.

1928 621 .9

CHAMPLY (R.), mécanicien-électricien.

Nouvelle encyclopédie pratique des constructeurs, mécaniciens, électriciens, chaudronniers. — Tome douzième : **Machines-outils et outillage (2e partie).** Machines à raboter, à mortaiser, à aléser et à sculpter, limes et râpes, étaux-limeurs, tours à bois et à métaux et outils pour tours, fraiseuses, toupies et tenonneuses.

Paris (6e), 15, rue des Saints-Pères; Liége, 1, quai de la Grande-Bretagne, Librairie polytechnique Ch. Béranger. In-8° (120 × 180), de 222 pages, avec 309 figures dans le texte. (Prix net : broché, 18 francs.)

1928 621 .35

JUMAU (L.), ingénieur-électricien, lauréat de l'Institut.

Etude résumée des **accumulateurs électriques.**

Paris (6e). Librairie Dunod, éditeur, 92, rue Bonaparte. Troisième édition. Un volume (160 × 250), VI-326 pages, 144 figures. (Prix, broché : 58 francs.)

1928 385. (09.1 (.64)

MÉCHIN (René), docteur en droit, ingénieur des Ponts et Chaussées, ingénieur en chef attaché à la Compagnie des Chemins de fer de l'Est français.

Les chemins de fer au Maroc.

Paris (5e). Les Presses Universitaires de France, 49, boulevard Saint-Michel. Un volume in-8° de 228 pages. (Prix : 25 francs.)

1928 62. (01

MESNAGER (M.), membre de l'Institut de France, professeur à l'Ecole des Ponts et Chaussées.

Cours de résistance des matériaux, professé au Conservatoire national des Arts et Métiers.

Paris (6e). Librairie Dunod, éditeur, 92, rue Bonaparte. Un volume (160 × 250), IV-347 pages, 330 figures. (Prix, broché : 76 francs.)

1928 721 .9 (02

PODEVYN (P. A.).

Traité pratique de béton armé spécialement destiné aux entrepreneurs, chefs de chantier, contremaîtres, conducteurs de travaux, dessinateurs et autres personnes désirant se mettre au courant de ce nouveau matériau. Deuxième édition revue et augmentée. In-8°, 136 pages avec 50 figures dans le texte et de nombreuses applications.

Saint-Amand (Cher), Impr. R. Bussière. — Paris, Libr. Centrale des Sciences Desforges, Girardot et Cie.

In German.

1928 624 .2

BERGER (Leopold).

Die wirtschaftliche Bemessung von Plattenbalken.

Berlin W. 8, Verlag von Wilhelm Ernst & Sohn, 56 Seiten, mit 16 Abb. (Preis : 6 Rm.)

1928 625 (.43) & 656 (.43)

Eisenbahnbau- und Betriebsordnung (B. O.) vom 17. Juli 1928. — In Uebereinstimmung mit dem im Reichgesetzblatt veröffentlichten Wortlaut.

Leipzig. Verlag von Johann Ambrosius Barth. 7. Auflage. 8°, 82 Seiten mit 7 Anlagen. (Preis, geh. : 2 Rm.)

1928 621 .13 (02

GUTERMUTH (M. F.), Geheimer Baurat, Professor Dr.-Ing. e. h. (Darmstadt).

Die Dampfmaschine. — Bearbeitet in Gemeinschaft mit Professor Dr.-Ing. **A. Watzinger** (Drontheim).

Berlin W. 9. Verlag von Julius Springer. In 3 Bänden, xxx, 1 635 Seiten, mit über 2 000 Figuren im Text, 86 Tafeln u. 31 Tabellen. (Preis des Gesamtwerkes, geb. : 300 Rm.)

[1] The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway Science », by L. WEISSENBRUCH in the number for November, 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

1928 69. (02

KIRCHHOFF (R.).

Die Statik der Bauwerke. I. Band : Einführung in die graphische Statik. — Trägheits- und Zentrifugalmomente ebener Querschnitte. Normal- und Schubspannungen in geraden Stäben. — Theorie der statisch bestimmten ebenen Träger. Kinematische Theorie des ebenen Fachwerks. — Die Theorie des Raumfachwerks.

Leipzig. Verlag von Johann Ambrosius Barth. 2., neubearbeitete und erweiterte Auflage. Gr. 8°, VIII-392 Seiten mit 494 Textabb. (Preis, geh. : 26 Rm.)

1928 721 .9 (02

KRAUS (H. J.) und DISCHINGER (Fr.).

Handbuch für Eisenbetonbau. — Dachbauten, Kragdächer, Schalen und Rippenkuppeln.

Berlin W. 8. Verlag von Wilhelm Ernst u. Sohn. 1 Band, 390 Seiten, mit 584 Abb. (Preis : 25.50 Rm.)

1928 621 .116. (02

MOSER (M.).

Der Kesselbaustoff. — Abriss dessen, was der Dampfkessel-Ueberwachungs-Ingenieur von der Herstellung, den Eigentümlichkeiten und der Prüfweise des Baustoffs wissen muss.

Leipzig. Verlag vom Johann Ambrosius Barth. 3. durchges. u. erg. Auflage 4°, IV, 29 Seiten mit 143 Abb. (Preis, geh.: 7.50 Rm.)

1928 691

REICHSBAHN-DIREKTION.

Anweisung für Mörtel und Beton.

Berlin W. 8. Verlag von Wilhelm Ernst & Sohn. 66 Seiten, mit Abb. u. Tafeln. (Preis : 4 Rm.)

1928 624. (02

SCHAU (A.).

Der Brückenbau. Leitfaden für den Unterricht an den Tiefbauabteilungen der Baugewerkschulen und verwandten technischen Lehranstalten. Teil 1 : Allgemeines. Durchlässe und massive Brücken. Hölzerne Brücken. Unterhaltung. Ueberschlägliche Kostenberechnungen.

Leipzig. Verlag von Johann Ambrosius Barth. 4. Auflage. Gr. 8°, x-216 Seiten, mit 345 Abb. im Text u. 6 Tafeln. (Preis, Kart. : 6.60 Rm.)

1928 62. (03

SCHLOMANN (Alfred).

Illustrierte technische Wörterbücher in 6 Sprachen. Deutsch, English, Russisch, Französisch, Italienisch, Spanisch. — Band II. **Elektrotechnik und Elektrochemie.**

Berlin. Technische Wörterbücher-Verlag G. m. b. H. — Alleinauslieferung für In- und Ausland : VDI-Verlag, G. m. b. H., Berlin NW 7. — Verbesserte, vervollständigte und stark vermehrte Auflage. Mit 3 965 Abbildungen u. zahlreichen Formeln. (Preis : 80 Rm.)

1928 62. (01

TIMOSHENKO (S.) und LESSELLS (M.).

Festigkeitslehre. — Deutsche Übersetzung von I. Malkin.

Berlin W. 9. Verlag von Julius Springer. 1 Band, 484 Seiten, mit 391 Abb. (Preis : 28 Rm.)

In English.

1928 656 .22 (

ALLEN (Cecil J.), M. Inst. T., A. I. Loco. E.

Famous Trains.

Liverpool, Meccano Limited, Binns Road. (7 [illegible] × 5 inches), 192 pages, 58 illustrations. (Price : 2 [illegible] 6 d. net.)

1928 656 .25 (06 (08 (.7

AMERICAN RAILWAY ASSOCIATION. Signal S[illegible] tion.

Minutes, eighty-third stated meeting, Ambassad[illegible] Hotel, Atlantic City, N. J., September 11, 12, 13, 19[illegible]

New York, N. Y. Published by the Signal Sectio[illegible] American Railway Association, 30, Vesey Stre[illegible] 409 pages & fig.

1928 656 .256.3 (.7

American railway signaling principles and practic[illegible] Chapter VII. Direct current track circuits.

New York. Published by the Signal Section, Ame[illegible] ican Railway Association, 30, Vesey Street. 31 + [illegible] pages. (Price : 15 cents to railroad employees; 25 cen[illegible] to non-railroad employees.)

1928 656 .256.3 (.7

American railway signaling principles and practic[illegible] Chapter VIII. Transformers.

New York. Published by the Signal Section, Ame[illegible] ican Railway Association, 30, Vesey Street. 31 + [illegible] pages. (Price : 15 cents to railroad employees; 25 cen[illegible] to non-railroad employees.)

1928 656 .254 (.7

American railway signaling principles and practic[illegible] Chapter XXIII. Highway crossing protection.

New York. Published by the Signal Section, Ame[illegible] ican Railway Association, 30, Vesey Street. 21 + [illegible] pages. (Price : 10 cents to railroad employees; 20 cen[illegible] to non railroad employees.)

1928 5[illegible]

Applied Heat. — An english translation of D[illegible] Wärme-Ingenieur, by Julius **OELSCHLAEGER.** Edit[illegible] by H. Moss, D. Sc. (London).

London. Blackie and Son, Limited. (Price : 30 [illegible] net.)

1928 621 .333 (.4[illegible]

British Standard specification for the electrical pe[illegible] formance of traction motors.

London, E. C. 4. Crosby Lockwood & Son, 7, St[illegible] tioners' Hall Court. 20 pages. (Price : 2 sh. 2 d.)

1928 385. (09.3 (.7[illegible]

Bulletin No. 17, The Railway and Locomotive Histo[illegible] ical Society. Includes « Dates of some of the princip[illegible] events in the history of 100 years of the railroad [illegible] New England », by Warren Jacobs, « Train speeds a[illegible] safety in 1826, as expounded in the early writings [illegible] Clandius Crozet », by Elizabeth O Cullen, « The b[illegible] ginning of S. P. », by D. L. Joslyn. Part II of « Hi[illegible] torical notes on locomotive design (1840-1890) by E. [illegible] Young, and « South Carolina Canal and Rail Road [illegible] by G. E. Mauldin. Illustrated, 87 p.

Boston, Mass. Published by Railway and Locomoti[illegible] Historical Society. (Price : $ 1.00.)

1928 313 .385 .114 (.73)

BUREAU OF STATISTICS (INTERSTATE COMMERCE COMMISSION, U. S. A.).

Unit costs of railroad service, 1915-1927. (A « study submitted to the Commission by the Director of Statistics ») and issued as Bureau of Statistics Statement No. 28152.

Washington, D. C. Published by Interstate Commerce Commission. Apply.

1928 621 .132.3 (.42) & 656 .222.1 (.42)

CHAPMAN (W. G.).

The « King » of railway locomotives.

London W. 2. Published by the Great Western Railway, Paddington station. 110 illustrations. (Price : 1 sh.)

1928 691. (02

ECKEL (Edwin C.), C. E., Affiliate, Am. Soc. C. E., Fellow, Geological Society of America; formerly Major, Engineers, U. S. A.

Cements, limes and plasters. Their materials, manufacture and properties.

Third edition, reviewed by P. H. Bates, Chief, Silicate Division, U. S. Bureau of Standards, Washington D. C., with chapter on alumina cements and high-strength Portlands.

New York : John Wiley & Sons, Inc. London : Chapman & Hall, Ltd. — Cloth : 6 × 9 inches, 619 pages; 162 illustrations; 269 tables. (Price : $ 7 net.)

1928 621 .33

ELECTRIFICATION OF STEAM RAILROADS COMMITTEE 1927-1928.

Serial report. Data for 27 countries given. Publication No. 278-103, 35 pages. Published by National Electric Light Association, New York. (Price : 55 cents.)

1928 621 .139, 625 .18 & 625 .27

GUSHEE (E. T.) and BOFFEY (L. F.).

Scientific purchasing. 1 vol., 5 3/4 × 9 inches. 196 pages, bound in cloth. New York, McGraw-Hill Book Company, Inc., Publishers, 370, Seventh Avenue. (Price: $ 3.)

1928 385 .13 (.73)

HSIEN-JU HUANG.

State taxation of railways in the United States. Discusses development of railway taxation, « property as a criterion : the ad valorem system », « property as a criterion : the capitalization system », « income as a criterion : taxation of earnings ». Part I takes up theories of railway taxation. 209 pages. Published by Columbia University Press. New York.

1928 69 (02

HUSBAND (J.) and HARBY (W.).

Structural Engineering. Fourth edition revised and enlarged. London : Longmans, Green and Co., Ltd. (Price : 16 sh. net.)

1928 621.3

KAPP (R. O.).

Electrical transmission and distribution. Part. I.

London, W. C. 2. Sir Isaac Pitman and Sons, Ltd., Parker street, Kingsway. (Price : 1 sh. net.)

1928 659

London : Town and Country. A guide for the Resident and the Visitor.

London. Prepared by the London « Underground » and published by the St. Catherine Press, Stamford Street, Waterloo Road, S. E. 300 pages. (Price : 1 sh. net.)

1928 69 (02

LORD (Arthur R.), C. E., President Lord & Halinger, Architectural Engineers, Chicago.

Handbook of reinforced-concrete building design in accordance with the 1928 Joint Standard Building Code.

Chicago, Portland Cement Association, Concrete Reinforcing Steel Institute, Rail Steel Bar Association. (6 × 8 inches), 261 pages and line cuts.

1928 624 .52 (.593)

LUANG PRAKOB YANTRAKICH.

Rama VI Bridge (Siamese State Railways). Published as Nos. 1 and 4 of « Technical and Scientific supplements to the Record » issued by the Ministry of Commerce and Communications to make known Siamese research and achievements and so avoid duplication of research and effort. 2 vol. Bangkok. Published by Ministry of Commerce and Communications.

1928 621 .36 (02

McKINNON (E. C.), M. I. E. E.

The A. B. C. of storage battery management. 1 vol. (8 1/2 × 5 1/2 inches), 121 pages.

Clifton Junction, near Manchester, The Chloride Electrical Storage Co. Ltd. (Price : 3 sh. 6 d.)

1928 62. (01

MERRIMAN (M.).

Strength of materials. Revised by **T. MERRIMAN.**

London, W. C. 2, Chapman & Hall, Ltd., 11, Henrietta street. (Price : 8 sh. 6 d. net.)

1928 62. (01

MORLEY (Arthur), D. Sc.

Strength of materials.

London. Longmans Green and Company, Limited. Seventh edition. (Price : 12 sh. 6 d. net.)

1928 659 .73

Posters and Publicity. Fine printing and design, 1928 Annual of Commercial Art. Posters of the following railways are included : Austrian Federal, Chikuba Ry. Bureau, Great Western (Great Britain), London Midland & Scottish, London & North Eastern, London's Underground, Nagoya Ry. Bureau, Norvegian State Rys, Paris-Lyon-Méditerranée; Sendai Ry. Bureau, Southern Ry. (Great Britain), Tokyo Ry. Bureau. Indexed by Advertisers, Designers, Printers and Agents. 162 pages.

New York City. Published by Wm. Edwin Rudge. (Price : $ 3.)

1928 621 .133.1 (06 (08 (.73)

Proceedings of the International Railway Fuel Association.

Chicago. Published by the International Railway Fuel Association, 313, Railway Exchange. (6 × 9 inches) 564 pages, illustrated.

1928 621 .116

PULL (E.).

Modern steam boilers. Their construction, management and use.

London. Ernest Benn, Limited. Second edition, revised and enlarged. (Price : 25 sh. net.)

1928 656 .214 (.42)

RAILWAY CLEARING HOUSE, LONDON.

Railway Junction Diagrams. Revised edition. Published by The Railway Clearing House, 123. Seymour Street. London N. W. 1. (Price : 30 sh. post free.)

1928 351 .757 (.42)

Requirements of passenger lines and recommendations for goods lines of the Minister of Transport in regard to railway construction and operation. Includes also fire precautions for electrically operated railways (Appendix 1), Clearances (Appendix 2), and requirements regarding brakes (Appendix 3).

London. Published by H. M. Stationery Office. New York City, British Library of Information. 22 pages. (Price : 1 sh.)

1928 625 .214

SANDERS (W. C.).

Roller bearings for railway equipment. Paper before Associated Engineers Club, Spokane, Washington. 5 pages.

Publ. by Author, Canton Ohio. Apply.

1928 313 .385 (.942) & 385. (08 (.942)

SOUTH AUSTRALIAN RAILWAYS.

Annual report of the South Australian Railways Commissioner for the year 1927-28.

Adelaide. Harrison Weir. Government Printer, North Terrace. xxxix + 33 pages, including 21 tables, also fig. & a map.

1928 621 .116

SPIERS (H. M.).

Technical data on fuel.

London. W. C. 2. The World Power Conference, 36, Kingsway. (Price : 10 sh. 6 d. net.)

1928 385. (09.3 (.73

STARR (John W., Jr.).

One hundred years of American railroading. 33 pages, 5 1/2 × 8 inches, bound in cloth, illustrated.

Published by Dodd, Mead & Company, Inc. New Yor (Price : $ 3.50.)

1928 62. (0

SUTTON PIPPARD (A. J.).

Strain energy methods of stress analysis.

London, Longmans, Green & Co., Ltd., 39 Paternoste Row, E. C. 4. 146 pages. (Price : 14 sh. net.)

1928 66

VERNON (W. H. J.).

A bibliography of metallic corrosion.

London. W. 1. Edward Arnold and Co., 41, Maddo street. (Price : 21 sh. net.)

In Spanish.

1928 62. (0

Manual del Ingeniero Hütte. Tomo III. Traducció de la 24 edición alemana, por Rafael Hernández.

Barcelona, Gustavo Gili, editor. Un vol. (190 × 135 con XIV + 1 419 páginas y 361 figuras. (Precio : 36 pe setas.)

1928 624. (0

MENDIZABAL (Domingo), ingeniero de caminos.

Estudio y construcción de tramos metalicos. Tomos y II.

Madrid. Sucesores de Rivadeneyra (S. A.). Arte Gráficas. Paseo de San Vicente, 20. (19 × 26 cm. Tomo I : 471 paginas; tomo II : 584 paginas. 1 285 fi y 15 hojas fuera texto.

1927 62. (0

TERRADAS (E.).

De la estabilidad geométrica en estructuras elástica Conferencia dada en Madrid, en la Escuela de Inge nieros de Caminos, Canales y Puertos, el 12 de may de 1926. Un volumen de 15.5 × 21 cm.; IV + 262 pa ginas.

Madrid. Talleres. Voluntad, Serrano, 48.

In Italian.

1928 721 .9 (0

AROSIO (G.).

Manuale dell' Ingegnere progettista e costruttore d cementi armati.

Milano, Ulrico Hoepli, editore. In-8° de 396 pagine 615 fig. (Prezzo : Lire 28.)

[016 .385. (05]

II. — PERIODICALS.

In French.

Arts et Métiers. (Paris.)

1928 625 .143.3 & 625 .212
Arts et Métiers, novembre, p. 427.
MERCOYROL (A.). — **Graissage des boudins des roues pour atténuer leur usure et celle des rails.** (2 300 mots & fig.)

1928 621 .133.1
Arts et Métiers, novembre, p. 430.
DELESQUES. — Emploi du **pétrole brut comme combustible sur les locomotives.** (3 000 mots & fig.)

Bulletin des transports internationaux par chemins de fer. (Berne.)

1928 385 .113 (.44)
Bull. des transp. intern. par ch. de fer, nov., p. 515.
Les **résultats de l'exploitation des cinq grandes compagnies** de chemins de fer en France en 1927. (3 600 mots & 3 tableaux.)

1928 313 .385 (.493)
Bull. des transp. intern. par ch. de fer, nov., p. 535.
Statistique des chemins de fer belges pour les exercices 1920-1925. (250 mots & 1 tableau.)

Bulletin technique de la Suisse romande. (Vevey.)

1928 62. (01
Bull. techn. de la Suisse romande, n° 21, 20 oct., p. 251.
PARIS (A.). — **Essais de déformation et détermination des efforts intérieurs probables.** (2 800 mots.)

Chronique des transports. (Paris.)

1928 656 .234 (.44)
Chronique des Transports, n° 20, 25 octobre, p. 2.
L'abaissement des tarifs-voyageurs en France. (1 500 mots.)

1928 656 .231 (.43)
Chronique des Transports, n° 20, 25 octobre, p. 29.
Le **relèvement des tarifs de la Reichsbahn.** (400 mots.)

1928 385 .113 (.593)
Chronique des Transports, n° 20, 25 octobre, p. 38.
La **situation favorable** des Chemins de fer de l'Etat siamois. (250 mots.)

1928 625 .1 (.44) & 656 .211 (.44)
Chronique des Transports, n° 21, 10 novembre, p. 2.
Trois inaugurations. — **La nouvelle gare de l'Est, à Paris. — La percée des Vosges. — La ligne Nice-Coni.** (3 500 mots.)

1928 385 .52 (.44)
Chronique des Transports, n° 21, 10 novembre, p. 12.
L'ajustement des salaires des cheminots, en France. (1 200 mots.)

1928 385 .517 (.44)
Chronique des Transports, n° 22, 25 novembre, p. 2.
L'**œuvre sociale** des grands réseaux français. (1 100 mots.)

1928 385 .113 (.492)
Chronique des Transports, n° 22, 25 novembre, p. 27.
Les **résultats financiers** des chemins de fer hollandais en 1927. (350 mots.)

Génie civil. (Paris.)

1928 621 .131.3 (.43) & 621 .133.1 (.43)
Génie civil, n° 2411, 27 octobre, p. 393.
Locomotive d'essais du réseau de l'Etat allemand **chauffée au lignite pulvérisé.** (1 500 mots & fig.)

1928 621 .138.5 & 625 .26
Génie civil, n° 2411, 27 octobre, p. 407.
L'aménagement des **ateliers de réparations** du matériel roulant. (600 mots.)

1928 625 .1 (.44 + .45)
Génie civil, n° 2412, 3 novembre, p. 417.
BLOT (G.). — La **ligne franco-italienne** de Nice à Coni, par Sospel. (5 000 mots & fig.)

1928 62. (01
Génie civil, n° 2412, 3 novembre, p. 432.
WOLKOWITSCH (D.). — Etude de l'**arc à deux articulations.** Vérification des calculs de stabilité à l'aide de la courbe de déformation de l'ouvrage sous l'influence des variations de la température. (1 000 mots & fig.)

1928 656 .25 (.43)
Génie civil, n° 2412, 3 novembre, p. 433.
La **sécurité des voyageurs** sur les chemins de fer allemands. (1 200 mots.)

1928 62. (01
Génie civil, n° 2413, 10 novembre, p. 448.
CAUFOURIER (P.). — Expériences américaines sur modèles réduits de **barrages-voûtes.** (5 000 mots & fig.)

1928 621 .132.3 (.494) & 621 .134.3 (.494)
Génie civil, n° 2414, 17 novembre, p. 469.

Locomotive à vapeur à 60 kilogrammes de la Société de Winterthur (Suisse). (2 100 mots, 2 tableaux & fig.)

1928 625 .5 (.44)
Génie civil, n° 2415, 24 novembre, p. 493.

LÉVY-LAMBERT (A.). — Le **funiculaire aérien** pour voyageurs de Chamonix à la montagne du Brévent. (7 000 mots, 1 tableau & fig.)

1928 621 .33 (.64)
Génie civil, n° 2415, 24 novembre, p. 500.

L'état actuel de l'**électrification** des Chemins de fer du Maroc. (3 000 mots & fig.)

1928 624 .63 (.44)
Génie civil, n° 2416. 1[er] décembre, p. 517.

CALFAS (P.). — Le **pont en béton armé** de la rue Lafayette, à Paris, au-dessus des voies des Chemins de fer de l'Est. (3 000 mots & fig.)

1928 621 .335 (.460)
Génie civil, n° 2416, 1[er] décembre, p. 534.

Locomotives à courant continu (3 000 volts) de la Société minière et métallurgique de Peñarroya (Espagne). (600 mots & fig.)

La Science et la Vie. (Paris.)

1928 669
La Science et la Vie, novembre, p. 373.

BOLL (M.). — Où en est notre **connaissance des métaux?** Comment sont constitués les **alliages**. Ce qu'est **l'écrouissage** et la **trempe**. (6 000 mots, 1 tableau & fig.)

Le Correspondant des Techniciens et Professionnels des chemins de fer. (Saint-Dizier, Haute-Marne.)

1928 625 .172
Le Correspondant des techn. et profes. des ch. de fer. n° 2, 15 février, p. 3.

BOUVET (M.). — **Entretien des voies.** — Une méthode : la révision générale. (1 800 mots.)

1928 625 .143.4
Le Correspondant des techn. et profes. des ch. de fer. n° 6, 15 juin, p. 3.

VANIEUX. — Note sur les **joints des rails.** (3 400 mots & fig.)

1928 656 .254 (.44)
Le Correspondant des techn. et profes. des ch. de fer, n° 7, 15 juillet, p. 3.

ESNAULT. — Sur le **despatching** français. (1 800 mots & fig.)

1928 625 .113
Le Correspondant des techn. et profes. des ch. de fer. n° 7, 15 juillet, p. 9.

CHAPPELET. — **Régularisation des courbes** par correction des flèches. (1 800 mots, 4 tables & fig.)

1928 625 .13 (.44)
Le Correspondant des techn. et profes. des ch. de fer, n° 9, 15 novembre, p. 3.

Reconstruction du pont Saint-Joseph, kil. 181.790 de la ligne de Charleville à Givet. (800 mots & fig.)

Les Chemins de fer et les Tramways. (Paris.)

1928 385. (01 (.66)
Les chemins de fer et les tramways, novembre, p. 238

A propos du **Transsaharien.** (2 600 mots & 1 carte.)

1928 621 .335
Les chemins de fer et les tramways, novembre, p. 241

SPIESS (E.). — Valeur des **locomotives électriques** mixtes. (4 200 mots & fig.)

1928 625 .234 (.494)
Les chemins de fer et les tramways, novembre, p. 246

Le **chauffage préalable des trains électriques** en Suisse. (4 000 mots & fig.)

1928 625 .162
Les chemins de fer et les tramways, novembre, p. 251

DUCHESNOY. — Les **clôtures** des chemins de fer (1 900 mots & fig.)

1928 625 .162 & 721 .9
Les chemins de fer et les tramways, novembre, p. 255

De la fabrication des **clôtures en ciment armé.** (800 mots & fig.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

1928 621 .335 & 621 .43
L'Ind. voies ferrées et transports autom., oct., p. 302

MELLINI et LA VALLE. — **Automotrices sur rail à moteurs à combustion interne.** — Rapport présenté au XXI[e] Congrès international (Rome, 6-12 mai 1928) (20 000 mots, 6 tableaux & fig.)

Revue du béton armé et des entreprises générales (Paris-Puteaux.)

1928 625 .142.
Rev. du béton armé et entr. gén., n° 110, 15 juil., p. 801

Quelques observations sur les **traverses en béton armé.** (2 200 mots & fig.)

Revue C. F. F. (Berne).

1928 621 .335 (.494)
Revue C. F. F., n° 10, 15 octobre, p. 22.

Die **Elektrischen Triebfahrzeuge** der Schweizerische Bundesbahnen. (1 100 mots & fig.)

Revue générale des chemins de fer. (Paris.)

1928 **625 .1 (.44 + .45)**

Revue générale des ch. de fer, novembre, p. 493.

MAUGUIN (A.). — **Ligne de Nice à Coni** avec embranchement de Breil vers Vintimille. (3 000 mots & fig.)

1928 **621 .132.8 (.44) & 656 .212.5 (.44)**

Revue générale des ch. de fer, novembre, p. 508.

RABOURDIN. — L'emploi dans les gares de triage du réseau de l'Est de **tracteurs** du type agricole. (2 000 mots & fig.)

1928 **385 .113 (.44)**

Revue générale des ch. de fer, novembre, p. 516.

Résultats d'exploitation des chemins de fer d'Alsace et de Lorraine en 1927. (2 600 mots.)

1928 **313 .385 (.44)**

Revue générale des ch. de fer, novembre, p. 523.

Résultats obtenus en 1927 sur le réseau des Chemins de fer de l'Etat en France d'après les comptes d'administration publiés pour ladite année. (10 tableaux.)

1928 **385 .113**

Revue générale des ch. de fer, novembre, p. 533.

Les **résultats d'exploitation** du premier exercice de la « Société nationale des Chemins de fer belges » 1926-1927. (4 000 mots & tableaux.)

1928 **656 .211.5 (.43)**

Revue générale des ch. de fer, novembre, p. 544.

Nouveau type d'**indicateur de départ des trains**. (650 mots & fig.)

1928 **621 .87 (.43)**

Revue générale des ch. de fer, novembre, p. 547.

Grue de secours des chemins de fer allemands. (400 mots & fig.)

1928 **621 .33 (.494)**

Revue générale des ch. de fer, novembre, p. 549.

L'électrification des chemins de fer suisses. (400 mots & fig.)

1928 **621 .134.3 (.43)**

Revue générale des ch. de fer, novembre, p. 551.

Locomotive à haute pression système Schwartzkopff-Löffler. (1 500 mots & fig.)

1928 **621 .131.3 (.43)**

Revue générale des ch. de fer, novembre, p. 558.

Essai d'une locomotive Gt 96°, type Mallet 0-8-0 + 0-8-0 modifiée par les Chemins de fer du Reich. (3 100 mots & fig.)

Revue politique et parlementaire. (Paris.)

1928 **385 .517 (.44) & 656 (.44)**

Revue politique et parlementaire, 10 novembre, p. 331.

PAYEN (E.). — **Revue des questions de transport.** — Les **institutions patronales** des grandes compagnies. — La batellerie française. — Le Ministère de l'air. (3 600 mots.)

Revue universelle des transports et des communications. (Paris.)

1928 **621 .132.8 & 621 .43**

Rev. univers. des transp. et des com., août, p. 77.

WAGNER (D. R. P.). — L'utilisation des **locomotives Diesel** sur les voies ferrées secondaires. (3 300 mots.)

1928 **385. (09.1 (.44)**

Rev. univers. des transp. et des com., août, p. 81.

REMOND (G.). — Le **Réseau de Paris-Lyon-Méditerranée** en 1927. (1 800 mots.)

In German.

Elektrotechnische Zeitschrift. (Berlin)

1928 **621 .33 (.485)**

Elektrotechnische Zeitschrift, Heft 42, 18. Okt., S. 1534.

Von der **Elektrisierung** der Staatsbahn Stockholm-Gothenburg. (1 100 Wörter & Abb.)

1928 **621 .33 (.73)**

Elektrotechnische Zeitschrift, Heft 43, 25. Okt., S. 1577.

BUTTLER. — Die **Elektrisierung** der Vorortbahnen von Chicago. (1 700 Wörter, 1 Tafel & Abb.)

1928 **621 .3**

Elektrotechnische Zeitschrift, Heft 44, 1. Nov., S. 1597.

MELLER. — **Elektrischer Antrieb von Werkzeugmaschinen.** (2 200 Wörter.)

1928 **621 .335 (.436)**

Elektrotechnische Zeitschrift, Heft 44, 1 Nov., S. 1616.

Talschnellzuglokomotive mit Einzelachsantrieb der Oesterreichischen Bundesbahnen. (800 Wörter.)

1928 **621 .33 (.436)**

Elektrotechnische Zeitschrift, Heft 45, 8. Nov., S. 1653.

Die **Elektrisierung** der Bahnstrecke Salzburg-Wien der Oesterreichischen Bundesbahnen. (1 100 Wörter u. 1 Tafel.)

1928 **621 .133.1 (06 (.42)**

Elektrotechnische Zeitschrift, Heft 46, 15. Nov., S. 1665.

MARGUERRE (F.). — Die **Brennstofftagung** der Weltkraftkonferenz in London. (3 500 Wörter & 1 Tafel.)

1928 **621 .33 (.460)**

Elektrotechnische Zeitschrift, Heft 46, 15. Nov., S. 1688.

Die **Elektrisierung** der spanischen Nordbahn und ihre wirtschaftlichen Ergebnisse. (1 700 Wörter.)

1928 **621 .335 (.436)**

Elektrotechnische Zeitschrift, Heft 48, 29. Nov., S. 1733.

LINSINGER (E.). — Entwicklung des Einzelachsantriebes für **elektrische Lokomotiven** durch die Oesterreichischen Siemens-Schuckert-Werke. (3 200 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1928 **621 .138.5 & 625 .26**
Glasers Annalen, Heft 9, 1. November. S. 113.
RUDOLPH (W.). — Neuere **Sandstrahlgebläse für das Eisenbahnwesen.** (4 300 Wörter & Abb.)

In English.

Electric Railway Journal (Chicago).

1928 **385 .59 (.73)**
Electric Railway Journal, No. 15, Oct. 13, p. 673.
Opportunities for **improving public relations through employee-customer contact.** (4 400 words.)

1928 **625 .214**
Electric Railway Journal, No. 15, Oct. 13, p. 677.
PENNIMAN (W. B. D.). — **Lubrication.** (2 200 words, 2 tables & fig.)

1928 **621 .335 (.73) & 621 .338 (.73)**
Electric Railway Journal, No. 16, Oct. 20, p. 710.
Many unusual features in new type **four-wheel cars.** (3 300 words & fig.)

1928 **625 .214**
Electric Railway Journal, No. 16, Oct. 20, p. 715.
KAUFFMAN (H. L.). — **Lubrication** of electric railway equipment. (2 400 words.)

1928 **621 .333**
Electric Railway Journal, No. 16, Oct. 20, p. 718.
ZIMMERMAN (J. M.). — Careful **maintenance of field coils** pays. (1 700 words & fig.)

1928 **621 .85 (.73)**
Electric Railway Journal, No. 16, Oct. 20, p. 721.
BENEDICT (H. A.). — **Shop methods** systematized for upkeep of 3 900 vehicles. (1 100 words & fig.)

1928 **621 .338**
Electric Railway Journal, No. 17, Oct. 27, p. 752.
GORDON (Ch.). — Many factors affect **car development.** (3 000 words.)

1928 **656**
Electric Railway Journal, No. 18, Nov. 3, p. 792.
BARNES (J. P.). — Expedients have no place in solution of **modern transportation problems.** (3 200 words & fig.)

1928 **621 .338**
Electric Railway Journal, No. 18, Nov. 3, p. 803.
Future **rolling stock** from viewpoints of operator and manufacturer. (2 800 words.)

1928 **621 .33 (.73)**
Electric Railway Journal, No. 18, Nov. 3, p. 806.
Pennsylvania **Railroad to be electrified** from New York to Wilmington. **$ 100 000 000 project** will cover 1 300 miles of track and will require 365 new electric locomotives. (1 200 words & fig.)

1928 **385 .586 (.73)**
Electric Railway Journal. No. 19, Nov. 10, p. 830.
Specialized **employee training** pays in Milwaukee. (2 300 words, 5 tables & fig.)

1928 **625 .6 (.52)**
Electric Railway Journal, No. 19, Nov. 10, p. 839.
KANAYA (S.). — **Transportation in Japanese cities.** (1 500 words, tables & fig.)

1928 **625 .614 (.73)**
Electric Railway Journal, No. 20, Nov. 17, p. 866.
HIBBARD (F. G.). — Mechanical methods expedite **track paving.** (2 100 words & fig.)

1928 **625 .614 (.73)**
Electric Railway Journal, No. 20, Nov. 17, p. 872.
Engineers make suggestions for improving **track and line maintenance.** (1 500 words.)

1928 **621 .31 (.73)**
Electric Railway Journal, No. 20, Nov. 17, p. 874.
ADAMS (M. J.). — Maintenance of **automatic sub stations.** (2 300 words & 1 table.)

1928 **625 .214 (.73)**
Electric Railway Journal, No. 20, Nov. 17, p. 878.
KAUFFMAN (H. L.). — Modern practices in **lubrication of electric railway equipment.** (1 900 words.)

1928 **625 .614 (.73)**
Electric Railway Journal, No. 21, Nov. 24, p. 908.
Buffalo Railway invests heavily in **street improvements.** (1 100 words & fig.)

1928 **625 .62 (.436)**
Electric Railway Journal, No. 21, Nov. 24, p. 916.
Vienna helps the passengers to use its service. (600 words & fig.)

1928 **621 .33 (.73) & 725 .33 (.73)**
Electric Railway Journal, No. 21, Nov. 24, p. 919.
Brooklyn **car terminal** enlarged. (1 500 words & fig.)

Engineer. (London.)

1928 **621 .31 (.42)**
Engineer, No. 3797, October 19, p. 422.
The No. 3 Lister Drive **power station.** (2 100 words & fig.)

1928 **621 .137.3**
Engineer, No. 3797, October 19, p. 426.
SAMS (J. G. B.). — The **diagramming of locomotive working.** (3 600 words & fig.)

1928 **621 .31 (.42) & 627 (.42)**
Engineer, No. 3797, October 19, p. 431.
The Maentwrog **generating station and electricity supply** in North Wales. (3 200 words & fig.)

1928 621 .116 (.42)
Engineer, No. 3798, October 26, p. 466.
Powdered fuel at a colliery. (1 500 words & fig.)

1928 624 .63 (.42)
Engineer, No. 3799, November 2, p. 478.
The new Cobden **bridge**, Southampton. (1 300 words & fig.)

1928 621 .132.8 (.54)
Engineer, No. 3799. November 2, p. 481.
Kalka-Simla Ry. — **Kitson-Meyer locomotives.** (1 000 words & fig.)

1928 621 .31 (.42)
Engineer, No. 3799, November 2, p. 493.
Coventry Corporation's Longford **power station.** (2 700 words & fig.)

1928 621 .132.8 (.43) & 621 .133.1 (.43)
Engineer, No. 3799, November 2, p. 495.
CLUBLEY ARMSTRONG (J.). — **Pulverised fuel locomotives.** (5 000 words & fig.)

1928 656 .211.7 (.82)
Engineer, No. 3799, November 2, p. 498.
Diesel-electric ferry boat. (1 000 words & fig.)

1928 656 .212.6 (.42)
Engineer, No. 3800, November 9, p. 528.
3 1/2 ton self-propelling steam jib crane. (500 words & fig.)

1928 625 .111 (.85)
Engineer, No. 3800, November 9, p. 528.
HINXSON (F. F.). — **Tunnel construction and main line deviation** on the Central Railway of Peru. (1 200 words.)

1928 621 .132.3 (.73)
Engineer, No. 3801. November 16, p. 539.
New York Central **express passenger locomotives.** (2 000 words & fig.)

1928 656 .254 (.42)
Engineer, No. 3801, November 16, p. 542.
Light-controlled **electrical circuits.** (1 400 words & fig.)

1928 625 .142.2
Engineer, No. 3801, November 16, p. 549.
Steel railway sleepers. (1 500 words.)

1928 621 .31 (.42)
Engineer, No. 3801, November 16, p. 552.
Constant-current **electric driving on the « Austin » system.** (3 100 words & fig.)

1928 621 .116. (06 (.42)
Engineer, No. 3802, November 23, p. 570.
The Institute of Fuel. (2 200 words.)

1928 621 .132.8 (.42) & 621 .43 (.42)
Engineer, No. 3802, November 23, p. 580.
A heavy-oil engine locomotive. (1 000 words & fig.)

1928 621 .12
Engineer, No. 3802, November 23, p. 581.
JEFFERSON (C. J.), EVANS (J. S.) & BROSHEK (J.). — Development of **pulverized fuel for marine purposes** during 1927-1928. (4 300 words, 2 tables & fig.)

1928 62. (01 (06
Engineer, No. 3802, November 23, p. 583.
The new International Association for **Testing Materials.** (1 100 words.)

1928 621 .39 & 621 .94
Engineer, No. 3802, November 23, p. 584.
A **wheel lathe electric control panel.** (1 200 words & fig.)

1928 621 .31 (.42)
Engineer, No. 3803, November 30, p. 601.
Barton **power station** extension. (1 200 words, 2 tables & fig.)

1928 625 .233 (.42)
Engineer, No. 3803, November 30, p. 605.
The **gas lighting of trains.** (2 000 words.)

1928 621 .133.2
Engineer, No. 3803, November 30, pp. 606 and 611.
Locomotive fire-boxes. (1 200 and 900 words.)

1928 621 .31 (.42)
Engineer, No. 3803, November 30, p. 609.
The new Brimsdown **power station.** (2 500 words & fig.)

1928 656 .211.7 (.73)
Engineer, No. 3803, November 30, p. 612.
A rolling stock transport steamer. (700 words & fig.)

1928 669
The Metallurgist, p. 165, Sup. Eng., No. 3803, Nov. 30.
Inverse segregation. (2 000 words & fig.)

1928 625 .143.2
The Metallurgist, p. 167, Sup. Eng., No. 3803, Nov. 30.
Heat treatment of rails. (800 words.)

1928 669 .1
The Metallurgist, p. 171, Sup. Eng., No. 3803, Nov. 30.
Advances in **cutting tools.** (800 words.)

1928 621 .89 & 669
The Metallurgist, p. 174, Sup. Eng., No. 3803, Nov. 30.
Bearing metals. (1 400 words & 1 table.)

Engineering. (London.)

1928 621 .131.3 (.43)
Engineering, No. 3275, October 19, p. 480.
Experimental locomotives on the German Railways. (3 200 words.)

1928 **624 .62 (.42)**
Engineering, No. 3275, October 19, p. 488.
The River Tyne **bridge,** Newcastle. (1 800 words & fig.)

1928 **621 .31 (.42) & 627 (.42)**
Engineering, No. 3275, October 19, p. 496.
The Maentwrog **hydro-electric development** of the North Wales Power Company. (900 words & fig.)

1928 **621 .335 (.460) & 621 .43 (.460)**
Engineering, No. 3275, October 19, p. 497.
Diesel-electric rail car for the Pamplona-San Sebastian Railway. (2 100 words & fig.)

1928 **624 .51 (.73)**
Engineering, No. 3276, October 26, p. 511.
The construction of the Delaware River **suspension bridge.** (2 200 words & fig.)

1928 **621 .116 (.42)**
Engineering, No. 3276, October 26, p. 522.
Pulverised fuel plant for the use of colliery waste. (2 800 words & fig.)

1928 **51. (08**
Engineering, No. 3276, October 26, p. 530.
CALLENDAR (H. L.). — **Steam tables and equations** extended by direct experiment to 4 000 lb. per square inch and 400 degrees C. (3 100 words & fig.)

1928 **669 .1**
Engineering, No. 3276, October 26, p. 537.
HERRERO (A.) and de ZUBIRIA (M.). — The phenomena of **corrosion of iron and steel.** (2 200 words & 1 table.)

1928 **621 .33**
Engineering, No. 3276, October 26, p. 541.
CRAMP (W.). — The possible application of high-frequency power to **electric traction.** (2 700 words, 2 tables & fig.)

1928 **621 .31 (.42)**
Engineering, No. 3277, November 2, p. 549.
The Longford **generating station** of the Coventry Corporation. (4 300 words & fig.)

1928 **656 .211.7 (.82)**
Engineering, No. 3277, November 2, p. 564.
Diesel-electric ferry boat for the Argentine Government. (1 500 words & fig.)

1928 **62. (01**
Engineering, No. 3277, November 2, p. 569.
MALAM (J. E.). — The Rockwell **hardness test.** (3 000 words, 1 table & fig.)

1928 **656 .212.6 (.42)**
Engineering, No. 3278, November 9, p. 584.
Petrol-driven mobile crane. (800 words & fig.)

1928 **62. (01 & 66**
Engineering, No. 3278, November 9, p. 597.
DOCHERTY (J. G.). — The effect of the velocity o **test on notch brittleness.** (3 000 words, 7 tables & fig.)

1928 **625 .4 (.42)**
Engineering, No. 3279, November 16, p. 608.
The reconstruction of the Piccadilly Circus tube railway station, London. (4 100 words & fig.)

1928 **621 .134.2 (.42)**
Engineering, No. 3279, November 16, p. 616.
Valve gear with independent cut-off and exhaust (1 400 words & fig.)

1928 **621 .3**
Engineering, No. 3279, November 16, p. 621.
Electric railway standardisation. (2 000 words.)

1928 **66**
Engineering, No. 3279, November 16, p. 629.
SMITHELLS (C. J.), WILLIAMS (S. V.) and AVERY (J. W.). — Laboratory experiments on **high temperature resistance alloys.** (3 900 words, 4 table & fig.)

1928 **621. (06 (.42**
Engineering, No. 3280, November 23, p. 644.
The Cardiff **engineering exhibition.** (3 400 words & fig.)

1928 **625 .122 (.42**
Engineering, No. 3280, November 23, p. 661.
232-ton steam **drag-line excavator.** (800 words & fig.)

1928 **621 .8**
Engineering, No. 3280, November 23, p. 661.
SWIFT (H. W.). — **Power transmission by belts** an investigation of fundamentals. (4 000 words, 2 ta bles & fig.)

1928 **621 .39**
Engineering, No. 3280, November 23, p. 664.
LLEWELLYN (F. T.). — The present status o **structural steel welding.** (2 500 words, 4 tables & fig.

1928 **621 .33 (.68**
Engineering, No. 3280, November 23, p. 667.
Costs and operating results of **electric traction** i South Africa. (600 words.)

1928 **621 .116 (.42) & 621 .3**
Engineering, No. 3281, November 30, p. 675.
Electricity supply and fuel consumption. (1 5 words.)

1928 **621 .11**
Engineering, No. 3281, November 30, p. 676.
Weldless steel drums for **high-pressure boilers.** (1 0 words, 1 table & fig.)

1928 **621 .31 (.4**
Engineering, No. 3281, November 30, p. 685.
Overhead lines. (2 100 words.)

1928 62. (01 (06
Engineering, No. 3281, November 30, p. 688.
New International Association for Testing Materials. (1 200 words.)

1928 621 .43
Engineering, No. 3281, November 30, p. 695.
GOUDIE (W. J.). — The determination of standard efficiencies of **internal-combustion engines** by the energy chart. (2 800 words, 2 tables & fig.)

Engineering News-Record. (New-York.)

1928 625 .1 (.73)
Engineering News-Record, No. 16, October 18, p. 574.
Double tracking on the Missouri Pacific Railroad. (3 200 words & fig.)

1928 624 .3 (.73)
Engineering News-Record, No. 16, October 18, p. 583.
BERKENBLIT (S. E.). — Building rapid-transit **viaduct**, Kansas City. (2 900 words & fig.)

1928 624 .1 (.73)
Engineering News-Record, No. 17, October 25, p. 610.
Mining the palisades for **bridge anchorages**. (2 100 words & fig.)

1928 625 .111 (.73)
Engineering News-Record, No. 17, October 25, p. 614.
Pennsylvania Railroad **relocation** avoids suburban towns. (600 words & fig.)

1928 624. (0 (.73)
Engineering News-Record, No. 17, October 25, p. 616.
HELICK (R. H.). — Highway **bridge maintenance** in Allegheny County. (5 100 words & fig.)

1928 621 .392 (.73)
Engineering News-Record, No. 17, October 25, p. 628.
WOODRUFF (L. B.). — **Repairing a truss bridge** under traffic **by arc welding**. (800 words & fig.)

1928 624 .62 (.73)
Engineering News-Record, No. 18, November 1, p. 646.
Steel arch highway bridge across Colorado River. (2 300 words & fig.)

1928 625 .17
Engineering News-Record, No. 18, November 1, p. 650.
Engineering aspects of railway **track maintenance**. (1 600 words.)

1928 625 .142.3 (.54)
Engineering News-Record, No. 18, November 1, p. 651.
Reinforcing steel ties in India. (500 words & fig.)

1928 625 .13 (.73)
Engineering News-Record, No. 18, November 1, p. 655.
BERKENBLIT (S. E.). — Wet **tunnel** strengthened and **made tight** by false roof. (1 100 words & fig.)

1928 62. (01 & 624. (0
Engineering News-Record, No. 18, November 1, p. 666.
Tests on structural details flame-cut from I-beams. (800 words, 2 tables & fig.)

1928 691 (.73)
Engineering News-Record, No. 19, November 8, p. 686.
Long concrete trestle of precast units. (3 300 words & fig.)

1928 625 .176 (.6 + .8)
Engineering News-Record, No. 19, November 8, p. 697.
Widening gage on foreign narrow-gage railways. (500 words.)

1928 624 .8 (.73)
Engineering News-Record, No. 20, November 15, p. 722.
SPEIRS (W. H.). — Construction of Lackawanna **high-level crossing** over Hackensack River. (3 500 words, 1 table & fig.)

1928 691
Engineering News-Record, No. 20, November 15, p. 738.
DUNAGAN (W. M.). — New and simple method for determining **moisture content in aggregates.** (600 words & fig.)

1928 624 .32 (.73)
Engineering News-Record, No. 21, November 22, p. 764.
NITTEBERG (C. T.). — Ingenious method used to **float bridge spans** to site. (700 words & fig.)

1928 656 .211 (.73)
Engineering News-Record, No. 21, November 22, p. 766.
Enlargement of Union Station at St. Louis, Mo. (1 100 words & fig.)

1928 669 .1 (06 (.73) & 69 (06 (.73)
Engineering News-Record, No. 21, November 22, p. 772.
Fabricators discuss new and broader fields for **structural steel.** (1 800 words.)

1928 625 .122 (.73)
Engineering News-Record, No. 22, November 29, p. 794.
HARVEY (C. K.). — **Facing a 90-foot cut with concrete**, Liberty Bridge, Pittsburgh. (1 400 words & fig.)

1928 721 .1 (.73)
Engineering News-Record, No. 22, November 29, p. 799.
WEST (O. J.). — Cored out pipe **piles** used in sticky clay. (700 words & fig.)

1928 562
Engineering News-Record, No. 22, November 29, p. 806
PARKHURST (D. L.). — Unusual design in new **theodolite.** (2 000 words & fig.)

1928 625 .13 (.73)
Engineering News-Record, No. 22, November 29, p. 809.
Replacing a railway span at congested site (Pennsylvania Railroad). (1 800 words & fig.)

Great Western Railway Magazine. (London.)

1928 **656 .212 (.42)**
Great Western Ry. Magazine, November, p. 423.
Rail-head distribution. New depot at Ladbroke Grove. (1 500 words & fig.)

Journal of the Institute of Transport. (London.)

1928 **656. (0**
Journal of the Institute of Transport, Nov., p. 11.
Co-operation in transport. (9 800 words, 5 tables & fig.)

1928 **656 .26 (.42)**
Journal of the Institute of Transport, Nov., p. 29.
GRIFFITHS (H. R.). — **English docks.** Ownership and finance. (2 000 words.)

Locomotive Railway Carriage & Wagon Review. (London.)

1928 **621 .132.6 (.42)**
Loc. Ry. Car. & Wagon Rev., No. 435, Nov. 15, p. 345.
2-6-2 tank locomotive, Great Southern Railways of Ireland. (300 words & fig.)

1928 **621 .335 (.494)**
Loc. Ry. Car. & Wagon Rev., No. 435, Nov. 15, p. 349.
Electric locomotive for the Bernina Railway, Switzerland. (1 000 words & fig.)

1928 **621 .392**
Loc. Ry. Car. & Wagon Rev., No. 435, Nov. 15, p. 361.
Electric arc welding in railway workshops. (1 800 words & fig.)

1928 **625 .154 (.43)**
Loc. Ry. Car. & Wagon Rev., No. 435, Nov. 15, p. 368.
A combined **traverser and turntable.** (200 words & fig.)

London & North Eastern Railway Magazine. (London.)

1928 **621 .133.1 (.42)**
L. & N. E. Railway Magazine, November, p. 568.
Locomotive coal consumption. (900 words & fig.)

1928 **625 .2 (.42)**
L. & N. E. Railway Magazine, November, p. 575.
GRESLEY (H. N.). — **Railway carriage stock.** (1 400 words & fig.)

Mechanical Engineering. (New-York.)

1928 **385 (.73) & 62 (.73)**
Mechanical Engineering, November, p. 826.
BUDD (R.). — The mechanical engineer's part in increasing **railway efficiency.** (1 400 words.)

Modern Transport. (London.)

1928 **656 .254 (.73)**
Modern Transport, No. 501, October 20, p. 10.
Wireless on freight trains in the United States. (400 words & fig.)

1928 **385. (01 (.71)**
Modern Transport, No. 501, October 20, p. 4.
The **Hudson Bay route to Europe.** New railway to expedite grain shipments. (1 600 words.)

1928 **656**
Modern Transport, No. 502, October 27, p. 3.
BELL (R.). — **Trade and the railways.** (2 300 words.)

1928 **625 .245 (.73) & 656 .261 (.73)**
Modern Transport, No. 502, October 27, p. 7.
Road-rail containers. (2 900 words & fig.)

1928 **621 .133.1**
Modern Transport, No. 502, October 27, p. 11.
Pulverised **fuel for locomotives.** (1 400 words.)

1928 **725 .33 (.42)**
Modern Transport. No. 502, October 27, p. 17.
Latest municipal **overhaul depot for trams** and buses. (1 900 words & fig.)

1928 **621 .33 (.42)**
Modern Transport, No. 503, November, p. 3.
WALKER (Sir Herbert). — **Railway electrification.** Some financial and operating considerations. (2 200 words.)

1928 **621 .133.1 (.42)**
Modern Transport, No. 503, November 3, p. 5.
Locomotive engineers and pulverised fuel. (2 200 words.)

1928 **385 (.42)**
Modern Transport, No. 503, November 3, p. 9.
POLE (Sir Felix). — Future of **British railways.** (1 700 words.)

1928 **656 .261 (.73) & 725 .35 (.73)**
Modern Transport, No. 503, November 3, p. 16.
Organisation of a **department store.** (3 700 words & fig.)

1928 **385**
Modern Transport, No. 504, November 10, p. 3.
HENDERSON (Sir B. H.). — **Railway development.** Some problems for the Engineer. (1 600 words.)

1928 **621 .338 (.42)**
Modern Transport, No. 504, November 10, p. 4.
New **rolling stock** for District Railway. A Jubilee exhibition. (1 500 words & fig.)

1928 **621 .132.3 (.54)**
Modern Transport, No. 504, November 10, p. 7.
Standard type locomotives for Indian railways. New XC class (4-6-2) **heavy passenger engines** for broad gauge lines. (1 000 words, 1 table & fig.)

1928 725 .31 (.71)
Modern Transport, No. 504, November 10, p. 9.
Station architecture in Canada. (800 words & fig.)

1928 621 .33 (.68)
Modern Transport, No. 504, November 10, p. 10.
Completion of electrification of Capetown Suburban Lines. (3 300 words & fig.)

1928 621 .335 (.73) & 621 .43 (.73)
Morern Transport, No. 504, November 10, p. 13.
HARVEY (J. H.). — **Oil-electric locomotives** in the United States. Long Island Railway development. (2 600 words & fig.)

1928 385 (.8)
Modern Transport. No. 505, November 17, p. 3.
Railway enterprise in South America. A tribute to British engineers. (1 500 words.)

1928 656 .23 (.42)
Modern Transport, No. 505, November 17, p. 4.
HARVERSON (P. A.). — British Railways : The next step. **Reversion to penny a mile?** (1 700 words.)

1928 625 .26 (.73)
Modern Transport, No. 505, November 17, p. 8.
Modern Transport in the United States. — **Maintenance of underground railway rolling stock.** (4 200 words & fig.)

1928 656 .2 (.42)
Modern Transport, No. 505, November 17, p. 20.
Railway road service development. (800 words. 1 table & fig.)

1928 656 .2 (.42)
Modern Transport, No. 505, November 17, p. 21.
Railway motor coach services. **Facilities for carrying luggage.** (1 000 words & fig.)

1928 656 .225 (.73)
Modern Transport, No. 506, November 24, p. 7.
Modern Transport in the United States. — The **carriage of milk.** (900 words & fig.)

1928 656 .211.7 (.73)
Modern Transport, No. 506, November 24, p. 8.
Three-deck **train ferry.** « Sea train » for New Orleans-Havana service. (700 words & fig.)

1928 621 .132.8 (.42) & 621 .43 (.42)
Modern Transport. No. 506, November 24, p. 10.
Diesel engines for light locomotives. The new Kerr Stuart unit. (2 700 words & fig.)

1928 625 .245 (.42)
Modern Transport, No. 506, November 24, p. 13.
Transport of pulverised fuel. New type of **rail wagon.** (600 words & fig.)

Proceedings, American Society of Civil Engineers. (New-York.)

1928 347 .75 (.73)
Proceed. Amer. Soc. Civil Eng., p. 2437.
BUSH (Edward W.). — **Letting construction work** by competitive bidding. (10 500 words.)

1928 621 .31 & 627
Proceed. Amer. Soc. Civil Eng., p. 2457.
FREEMAN (William W. K.). — **Pumped-storage hydro-electric plants.** (6 400 words, 2 tables & fig.)

Proceedings, Institution of Railway Signal Engineers. (Manchester.)

1928 656 .253
Proceed., Institut Ry. Signal Eng., Febr. to Aug., p. 26.
PRESCOTT (C. W.). — **Speed and route signal aspects** compared. (10 000 words & fig.)

1928 656 .256.2
Proceed.. Institut Ry. Signal Eng., Febr. to Aug., p. 54.
LASCELLES (T. S.). — A short account of the **Siemens and Halske lock and block system.** (13 300 words & fig.)

1928 656 .257
Proceed., Institut Ry. Signal Eng., Febr. to Aug., p. 93.
ROSE (A. C.). — The **square sheet locking table.** (8 300 words & fig.)

1928 656 .25 (06 (08 (.42)
Proceed., Institut Ry. Signal Eng., Febr. to Aug., p. 118.
Institution of Railway Signal Engineers (Great Britain). **Proceedings** of the Eighth annual **summer meeting.** 1928. (33 000 words.)

Railway Age. (New-York.)

1928 656 .225 (.73)
Railway Age, No. 15, October 13, p. 698.
Moving strawberries on time. (2 400 words & fig.)

1928 625 .1 (.73)
Railway Age, No. 15, October 13. p. 701.
Frisco opens route into Pensacola. (3 600 words & fig.)

1928 313 : 656.256 (.73)
Railway Age, No. 15, October 13, p. 706.
Block signal mileage, 1928. (600 words & 4 tables.)

1928 656 .212.6 (.73)
Railway Age. No. 15, October 13, p. 707.
Lehigh Valley consolidades **inter-shop transport.** (1 900 words & fig.)

1928 656 .24 (.73)
Railway Age. No. 15, October 13, p. 713.
MARSHALL (J.). — **Claim prevention and freight car repairs.** (1 200 words & 2 tables.)

1928 625 .244 (.73)
Railway Age, No. 15, October 13, p. 715.
Refrigerator cars for the Fruit Growers Express Company. (1 600 words & fig.)

1928 385 .56 (.73)
Railway Age, No. 15, October 13, p. 719.
Railway employment stability study. (800 words & 7 tables.)

1928 656 .223.2 (.73)
Railway Age, No. 15, October 13, p. 721.
GORMLEY (M. J.). — Why **empty car mileage** has increased. (2 500 words.)

1928 621 .138.1 (.73) & 725 .33 (.73)
Railway Age, No. 16, October 20, p. 749.
Big Four completes **new terminal** at Cincinnati. (4 400 words & fig.)

1928 621 .39 (.73) & 621 .8 (.73)
Railway Age, No. 16, October 20, p. 757.
Diversified **electric power applications found at Paducah shops.** (5 800 words, 4 tables & fig.)

1928 625 .232 (.73)
Railway Age, No. 16, October 20, p. 764.
Combination **day and sleeping car.** (600 words & fig.)

1928 625 .232 (.73)
Railway Age, No. 16, October 20, p. 765.
Union Pacific gets new **coaches.** (2 200 words & fig.)

1928 656 .284 (.73)
Railway Age, No. 16, October 20, p. 768.
Fire Protection Association analyzes problems. (2 400 words & fig.)

1928 656
Railway Age, No. 16, October 20, p. 771.
DOWNS (L. A.). — **Transportation** from the Businessman's viewpoint. (2 500 words.)

1928 656 .212.5 (.73)
Railway Age, No. 16, October 20, p. 773.
Advance planning increases efficiency of new facility (Crestline **gravity yard**, Pennsylvania Railroad). (1 200 words & fig.)

1928 621 .133.7 (.73)
Railway Age, No. 16, October 20, p. 778.
New **water treater fits on locomotives.** (350 words & fig.)

1928 625 .14 (01 & 625 .212
Railway Age, No. 17, October 27, Section one. p. 794.
Track surface and car derailments. (1 200 words.)

1928 385 .21 (.73)
Railway Age, No. 17, October 27, Section one. p. 796.
Waterway claims and results. (2 000 words.)

1928 625 .14 (01 & 625 .212
Railway Age, No. 17, October 27, Section one. p. 798.
Tests to determine **truck action.** (2 000 words, 1 table & fig.)

1928 385 .21 (.73)
Railway Age, No. 17, October 27, Section one. p. 801.
What the **Barge Lines** are doing. (3 600 words, 1 table & fig.)

1928 656 (.73)
Railway Age, No. 17, October 27, Section one. p. 805.
Manufacturers hold transportation session (22-24 october). (4 200 words.)

1928 625 .1 (06 (08 (.73)
Railway Age, No. 17, October 27, Section one, p. 811.
Bridge and building men meet in Boston. (8 000 words & 1 table.)

1928 625 .156 (.73)
Railway Age, No. 17, October 27, Section one. p. 817.
The « Bull Frog » **highway crossing.** (800 words & fig.)

1928 313 .385.114 (.73)
Railway Age, No. 17, October 27, Section one. p. 818.
Unit costs of railroad service. — I. C. C. Bureau of statistics compares results for years 1915-1927. (900 words & 2 tables.)

1928 656 .2 (.73)
Railway Age, No. 17, October 27, Section two, p. 837
Operating Santa Fe's motor coaches (3 800 words & fig.)

1928 725 .33 (.73)
Railway Age, No. 17, October 27, Section two. p. 845
STEWARD (H. M.). — Points in **motor coach garage design.** (4 400 words & fig.)

1928 347 .763 (.42)
Railway Age, No. 17, October 27, Section two. p. 850
The new British **railway motor transport law.** (3 600 words.)

1928 656 .1 (06 (.73)
Railway Age, No. 17, October 27, Section two, p. 853
Record attendance at **Motor transport meeting** (Detroit, October, 24). (1 600 words.)

1928 656 .1 (06 (.73)
Railway Age, No. 17, October 27, Section two. p. 855
Society of Automotive Engineers holds meeting at Newark (October, 17-19). (3 200 words.)

1928 656 .1 (.73) & 656 .2 (.73)
Railway Age, No. 17, October 27, Section two. p. 858
FRITCH (H. F.). — **Making trains and motor coaches work together** (Boston & Maine). (1 100 words.)

1928 625 .258 & 656 .25
Railway Age, No. 18, November 5, p. 871.
HEALY (K. T.) and JACOBS (P. H.). — The economics of **car retarders.** (2 600 words, 6 tables & fig.)

1928 621 .33 (06 (.73)

Railway Age, No. 18, November 5, p. 875.

Electrical men hold Convention (Chicago, 23 to 26 october incl.). (4 500 words & fig.)

1928 621 .135. (01

Railway Age, No. 18, November 5, p. 881.

CAMPBELL (H. A. F.). — Modern **counterbalance** conditions. (1 100 words & fig.)

1928 656 .231 (.73)

Railway Age, No. 18, November 5, p. 883.

JOHNSON (A. B.). — A railway concert for maintenance of remunerative **rates**. (2 600 words.)

1928 385 .1 & 657

Railway Age, No. 18, November 5, p. 886.

Cost accounting plan opposed. (5 800 words.)

1928 656 .215 (.725)

Railway Age, No. 18, November 5, p. 896.

ARIAS (B. E.). — Mexican Railway finds **flood-lighting** advantageous. (500 words & 1 table.)

1928 656 .254 (.725)

Railway Age, No. 18. November 5, p. 899.

ARIAS (B. E.). — **Telephone dispatching** on National Railways of Mexico. (1 000 words, 1 table & fig.)

1928 656 .24

Railway Age, No. 18, November 5, p. 900.

Rough handling can be reduced through supervision and co-operation. (1 100 words.)

1928 656 .223.2 (.73)

Railway Age, No. 19, November 10, p. 915.

Need of heavier **car loading**. (1 400 words.)

1928 624 .8 (.73)

Railway Age, No. 19, November 10, p. 917.

Delaware, Lackawanna & Western completes three-track **lift-span bridge**. (5 000 words & fig.)

1928 385 .11 (.73)

Railway Age, No. 19, November 10, p. 924.

New York Central increases surplus. (1 300 words & 2 tables.)

1928 656 .212.8 (.73)

Railway Age, No. 19, November 10, p. 926.

A new **car spotter**. (300 words & fig.)

1928 385 .13 (.73)

Railway Age, No. 19, November 10, p. 927.

DAVIS (J. M.). — The **public's stake in railroad** prosperity. (2 100 words.)

1928 313 : 656.285 (.73)

Railway Age, No. 19, November 10, p. 929.

Chicago Great Western reduces **casualties** 88 per cent in 11 years. (2 600 words & fig.)

1928 621 .33 (.73)

Railway Age, No. 19, November 10, p. 933.

Narrow gauge railroad of Boston is electrified. (1 400 words & fig.)

1928 621 .132.6 (.73)

Railway Age, No. 19, November 10, p. 935.

Suburban **locomotives** for the Boston and Albany. (1 000 words & 1 table.)

1928 656 .28 (01 (.73)

Railway Age, No. 19, November 10, p. 937.

Accident investigations, second quarter 1928. (3 100 words.)

1928 625 .143.3 (.73) & 625 .245 (.73)

Railway Age, No. 20, November 17, p. 952 & 955.

Transverse fissures can now be located (Sperry detector). (700 words, 4 500 words & fig.)

1928 656 .225 (.73)

Railway Age, No. 20, November 17, p. 961.

Santa Fe **speeds up wheat movement**. (2 400 words, 3 tables & fig.)

1928 691 (.73)

Railway Age, No. 20, November 17, p. 965.

Factors in the economical **buying of lumber**. (3 000 words & fig.)

1928 625 .258 (.73)

Railway Age, No. 20, November 17, p. 968.

A new type of **car retarder**. (500 words & fig.)

1928 625 .231 (.73)

Railway Age, No. 20, November 17, p. 971.

Automobile baggage car on Southern Pacific. (600 words & fig.)

1928 621 .133.1 (.73)

Railway Age, No. 20, November 17, p. 973.

Texas & Pacific **fuel conservation** program. (800 words, 3 tables & fig.)

1928 385 .113 (.73)

Railway Age. No. 21, Nov. 24, Section one, p. 1005.

Economic situation in the railway industry. (2 100 words.)

1928 656 .254 (.73)

Railway Age, No. 21, Nov. 24, Section one, p. 1007.

Santa Fe improves its **communications facilities**. (1 400 words, 1 table & fig.)

1928 385. (0 (.73)

Railway Age. No. 21, Nov. 24, Section one, p. 1009.

Crowley talks on **problems of railways**. (1 300 words.)

1928 385 .3 (.73)

Railway Age, No. 21, Nov. 24. Section one, p. 1011.

State Commissioners meet at New Orleans. Favor national motor transport act despite opposition to increased federal powers in regulation. (5 000 words.)

1928 621 .13 (09.3 (.73)
Railway Age, No. 21, Nov. 24, Section one, p. 1016.
The « Best Friend of Charleston ». (700 words & fig.)

1928 625 .245 (.73)
Railway Age, No. 21, Nov. 24, Section one, p. 1017.
A humane **live stock car.** (800 words & fig.)

1928 385 .21 (.73)
Railway Age, No. 21, Nov. 24, Section one, p. 1019.
Procedure under the **Barge Line Act.** (1 500 words.)

1928 385. (06 (.73)
Railway Age. No. 21, Nov. 24, Section one, p. 1021.
Railway Business Association's meeting, November 21. (6 500 words.)

1928 621 .14 (.73)
Railway Age, No. 21, Nov. 24, Section one, p. 1027.
Boston and Maine reduces shifting costs of **passenger car shops.** (600 words & fig.)

1928 656 .1 (.73) & 656 .2 (.73)
Railway Age, No. 21, Nov. 24, Section two, p. 1047.
Plan large scale coach operation (Missouri Pacific and Cotton Belt). (1 500 words & fig.)

1928 656 .1 (06 (08 (.73)
Railway Age, No. 21, Nov. 24, Section two, p. 1050.
Important problems considered by the **Motor Transport Division** (A. R. A.). (9 000 words & fig.)

1928 656 .1 (.73)
Railway Age, No. 21, Nov. 24, Section two, p. 1064.
Reading's **coach operation** progresses. (1 400 words & fig.)

Railway Engineer. (London.)

1928 621 .133.3 (.73)
Railway Engineer, November, p. 391.
Electro-chemical attack on **boiler corrosion.** (330 words.)

1928 621 .132.8 (.62) & 625 .232 (.62)
Railway Engineer, November, p. 393.
Articulated **steam rail cars** for Egypt. (1 400 words & fig.)

1928 625 .1 (.42) & 625 .33 (.42)
Railway Engineer, November, p. 398.
ELLSON (G.) & COOPER (A. R.). — **Railway design and maintenance** as affected by the application of electricity. (2 200 words.)

1928 621 .111
Railway Engineer, November, p. 411.
NAYLOR (T. M.). — Estimating **steam consumption** of non-condensing engines. (1 200 words, 3 tables & fig.)

1928 625 .232 (.42)
Railway Engineer, November, p. 417.
Third-class **sleeping cars** in Great Britain. (1 600 words & fig.)

1928 621 .335 (.460) & 621 .43 (.460)
Railway Engineer, November. p. 420.
A new **Diesel-electric rail car.** (2 000 words & fig.)

1928 625 .13
Railway Engineer, November, p. 426.
Bridge maintenance. (800 words.)

Railway Engineering & Maintenance. (Chicago.)

1928 625 .144.4 (.73)
Railway Engineering & Maintenance, November, p. 466.
Cutting the cost of **ballasting work.** (3 300 words & fig.)

1928 614 .8 (.73) & 625 .17 (.73)
Railway Engineering & Maintenance, November, p. 471.
ROWLAND (R.). — Putting it up to the foreman. (2 600 words & fig.)

1928 625 .17 (.73)
Railway Engineering & Maintenance. November, p. 475.
SILLS (J. M.). — How long is a mile of track? A study of the factors to be used in equating mileage for **maintenance of way operation.** (3 000 words, 1 table & fig.)

1928 625 .1 (06 (08 (.73)
Railway Engineering & Maintenance, November, p. 478.
When **Bridge and Building Men** gather in Convention. — Report of the 38th annual meeting. (16 000 words & fig.)

Railway Gazette. (London.)

1928 656 .28 (0 (.42)
Railway Gazette, No. 16, October 19, p. 476.
Human fallibility and railway accidents. (650 words.)

1928 621 .132.6 (.42)
Railway Gazette, No. 16, October 19, p. 482.
New 0-6-2 **side tank engines,** London & North Eastern Ry. (250 words & fig.)

1928 625 .232 (.42)
Railway Gazette, No. 16, October 19, p. 483.
New **dining cars** for the Southern Railway. (1 700 words & fig.)

1928 385. (02 (.43)
Railway Gazette, No. 16, October 19, p. 487.
Popular booklets on **railway working.** (1 700 words.)

1928 621 .33 (.42) & 621 .4 (.42)
Railway Gazette, No. 16. October 19, p. 490.
A new **Diesel-electric rail car.** (1 000 words & fig.)

1928 656
Railway Gazette, No. 17, October 26, p. 513.
The trade and railway outlook. (5 000 words.)

1928 656 .222.6 (.44)
Railway Gazette, No. 17, October 26, p. 517.
Goods traffic by time-table. (600 words & fig.)

1928 656 .1 (06 (08
Railway Gazette, No. 17, October 26, p. 520.
The World Motor Transport Congress at Rome. (4 800 words.)

1928 656 .1 (.60)
Railway Gazette, No. 17, October 26, p. 524.
The Nigerian Railway and road transport. (550 words & fig.)

1928 621 .133.1
Railway Gazette, No. 18, November 2, p. 551.
Pulverised-fuel locomotives. (1 600 words.)

1928 656 .222.6 (.42) & 659 (.42)
Railway Gazette, No. 18, November 2, p. 553.
Goods train time-tables on the London Midland & Scottish Railway. (700 words & table.)

1928 625 .1 (.44 + .45)
Railway Gazette, No. 18, November 2, p. 554.
The Nice-Coni line of de Paris-Lyons-Mediterranean Ry. (1 800 words & fig.)

1928 385. (07 (.42)
Railway Gazette, No. 18, November 2, p. 559.
Railway Students' Association : London School of Economics (Opening meeting 1928-1929 session). (2 900 words & fig.)

1928 621 .132.8 (.42)
Railway Gazette, No. 18, November 2, p. 561.
New Clayton steam rail cars for Ireland. (800 words & fig.)

1928 656 .283 (.42)
Railway Gazette, No. 18, November 2, p. 569.
The Dinwoodie collision. (1 700 words & fig.)

1928 659 (.42)
Railway Gazette, No. 19, November 9, p. 588.
London & North Eastern Railway goods train services time-table. (500 words, 1 table & fig.)

1928 656 .2 (.42)
Railway Gazette, No. 19, November 9, p. 590.
Handling London's « Underground » traffic. (1 700 words & fig.)

1928 385 .3 (.42) & 621 .33 (.42)
Railway Gazette, No. 19, November 9, p. 594.
Electrification of railways. Report and recommendations of the Ministry of Transport 1927 Committee. (900 words.)

1928 621 .132.5 (.54)
Railway Gazette, No. 19, November 9, p. 595.
New 2-8-2 type freight locomotives for the Indian State Railways. (600 words & fig.)

1928 621 .134.2 (.42)
Railway Gazette, No. 19, November 9, p. 598.
A noteworthy design of reversing motion. (500 words & fig.)

1928 659 (.42)
Railway Gazette, No. 20, November 16, p. 622.
Great Western Railway freight train services. (1 600 words.)

1928 621 .33 (.82)
Railway Gazette, No. 20, November 16, p. 624.
Buenos Ayres suburban electrification. (900 words & 1 table.)

1928 621 .132.3 (.68) & 621 .132.5 (.68)
Railway Gazette, No. 20, November 16, p. 625.
New mixed-traffic locomotives for the South African Railways. (400 words & fig.)

1928 621 .132.8 (.54)
Railway Gazette, No. 20, November 16, p. 628.
New Kitson-Meyer locomotives, Kalka-Simla Railway. (700 words & fig.)

1928 621 .133.1
Railway Gazette, No. 21, November 23, p. 650.
The Institute of Fuel. Summary of a paper read by Sir Henry Fowler, K. B. E., on « Fuel Conservation Practice ». (1 200 words.)

1928 621 .132.6 (.42)
Railway Gazette, No. 21, November 23, p. 651.
Locomotive development on the Great Southern Railways, Ireland. (250 words & fig.)

1928 621 .132.8 (.42) & 621 .43 (.42)
Railway Gazette, No. 21, November 23, p. 652.
A new Diesel locomotive design. (1 100 words & fig.)

1928 351 .81 (.42)
Railway Gazette, No. 21, November 23, p. 654.
Railway Bills in Parliament. Air transport powers are being sought by each of the four principal Companies, who, in addition are promoting measures for general purposes. (1 400 words.)

1928 385 .14 (.42)
Railway Gazette, No. 21, November 23, p. 656.
Railway freights rebate. (1 000 words.)

1928 656 .1
Railway Gazette, No. 21, November 23, p. 659.
Motor transport in British Dependencies. (1 000 words.)

1928 656 .1 (.68)
Railway Gazette, No. 21, November 23, p. 660.
Co-operation between rail and road, South African Railways. (600 words.)

1928 656 .212 (.42)
Railway Gazette, No. 21, November 23, p. 661.
Railhead distribution at Ladbroke Grove. (800 words & fig.)

1928 656 .213 (.42)
Railway Gazette, No. 22, November 30, p. 694.
Mineral railways in Durham and Northumberland. (400 words & 1 map.)

1928 625 .142.3 (.42)
Railway Gazette, No. 22, November 30, p. 696.
The use of steel sleepers by British railways. (2 200 words.)

1928 659 (.42)
Railway Gazette, No. 22, November 30, p. 698.
Freight traffic on the Southern Railway. (500 words & 2 tables.)

1928 625 .232 (.68)
Railway Gazette, No. 22, November 30, p. 699.
New first-class sleeping carriages for the Rhodesia Railways. (500 words & fig.)

1928 621 .132.8
Railway Gazette, No. 22, November 30, p. 702.
Sentinel-Cammel gear driven rail cars. (900 words & fig.)

Railway Magazine. (London.)

1928 656 .222.1 (.42)
Railway Magazine, November, p. 371.
ALLEN (C. J.). — British locomotive practice and performance. (5 000 words, 5 tables & fig.)

Railway Mechanical Engineer. (New-York.)

1928 621 .132.8 (.42 + .82)
Railway Mechanical Engineer, October, p. 543.
The Ljungström turbine locomotive. (3 000 words, 4 tables & fig.)

1928 621 .13 (06 (.73) & 625 .2 (06 (.73)
Railway Mechanical Engineer, October, p. 549.
General foremen present constructive program. (7 900 words & fig.)

1928 625 .2 (06 (.73)
Railway Mechanical Engineer, October, p. 557.
Car supervisors meet in St. Louis. (7 800 words & fig.)

1928 621 .13 (06 (.73)
Railway Mechanical Engineer, October, p. 564.
Traveling engineers hold thirty-sixth convention. (11 000 words.)

1928 621 .138.3 (.73)
Railway Mechanical Engineer. October, p. 580.
PACK (A. G.). — The elimination of federal defects. (4 500 words.)

1928 621 .9 (06 (.73)
Railway Mechanical Engineer, October, p. 584.
D. C. Curtiss addresses tool men. (5 800 words & fig.)

1928 625 .235. (06 (.73)
Railway Mechanical Engineer, October, p. 590.
Equipment painting section meets at Montreal. (11 500 words & fig.)

South African Railways and Harbours Magazine. (Johannesburg.)

1928 385. (01 (.67)
South African Rys. & Harbours Ma., October, p. 1705.
WILLIAMS (W. C.). — Railway developments in Central Africa. (4 600 words & fig.)

University of Illinois Bulletin. (Urbana.)

1928 621 .165
University of Illinois Bulletin, No. 183. Oct. 16, p. 1.
MOORE (H. F.), LYON (S. W.) & ALLEMAN (N. J.). — Tests of the fatigue strength of steam turbine blade shapes. (5 600 words, 5 tables & fig.)

In Spanish.

Gaceta de los Caminos de hierro (Madrid.)

1928 625 .234
Gac. de los Cam. de hierro, nº 3564, 20 de Oct., p. 349.
Ventilación y calefacción de coches de viajeros. (1 000 palabras.)

1928 621 .138.5 (.44)
Gac. de los Cam. de hierro, nº 3566, 10 de Nov., p. 373.
Los talleres de reparación de locomotoras de los ferrocarriles del Estado francés. (2 400 palabras.)

Ingenieria y Construcción. (Madrid.)

1928 621 .33 (.460)
Ingenieria y Construcción, noviembre, p. 571.
SANCHEZ-MORENO BALACA (R.). — El ferrocarril Vigo. La Ramallosa. (6 200 palabras & fig.)

1928 621 .133.
Ingenieria y Construcción, noviembre, p. 602.
Empleo del carbón pulverizado en las locomotoras. (3 200 palabras & fig.)

Revista de Obras Públicas. (Madrid.)

1928 624 .32 (.460)
Revista de Obras Públicas, nº 21, 1º de nov., p. 372.
CEBALLOS PABÓN (R.). — Nuevo puente sobre el rio Guadalmez. (1 900 palabras & fig.)

1928 624 .2
Revista de Obras Públicas, nº 23, 1º de dic., p. 409.
MENDIZABÁL (D.). — Nuevos estudios sobre el impacto. (3 600 palabras & fig.)

1928 624 .2
Revista de Obras Públicas, nº 21, 1º de dic., p. 420.
PEÑA (A.). — Repartición de las cargas móviles de los ejes de un tren a lo largo de un puente. (1 500 palabras & fig.)

In Italian.

L'Ingegnere. (Roma.)

1928 624. (01
L'Ingegnere, ottobre, p. 592.
GUIDI (C.). — Prove di travi da ponte. (1 000 parole, 2 tabelle & fig.)

Rivista delle comunicazioni ferroviarie. (Roma.)

1928 624 .61 (.45)
Riv. delle Comunic. ferrov., nº 21, 1º novembre, p. 11.
Il ponte di Salcano. La costruzione del grande arco sull' Isonzo presso Gorizia. (1 000 parole & fig.)

Rivista tecnica delle ferrovie italiane. (Roma.)

1928 627. (492) & 656 .213 (.492)
Rivista tecn. delle ferrovie ital., nº 4, 15 ottobre, p. 138.
VANNI (E.). — Il carbone delle Ferrovie Italiane dello Stato e il porto di Rotterdam. (2 500 parole, 4 tavole & fig.)

1928 621 .138.1 (.45)
Rivista tecn. delle ferrovie ital., nº 4, 15 ottobre, p. 149.
CASSINIS (R.) e CUTTICA (A.). — Il nuovo deposito locomotive delle Ferrovie dello Stato di Firenze S. M. N. (6 000 parole, 5 tavole & fig.)

1928 385. (09.1 (.45)
Rivista tecn. delle ferrovie ital., nº 4. 15 ottobre, p. 166.
TOSTI (L.). — Miglioramenti apportati in questi ultimi anni nelle Ferrovie Italiane dello Stato. (5 000 parole.)

In Dutch.

De Ingenieur. (Den Haag.)

1928 385. (09.1 (.44) & 656 .211 (.44)
De Ingenieur, Nr 42, 20 October, p. V. 93.
LAMAN TRIP (G. J.). — Iets over de « Compagnie des chemins de fer de l'Est » in Frankrijk en over de uitbreidingswerken van haar station te Parijs. (5 900 woorden, tafereelen & fig.)

1928 625 .14 (01
De Ingenieur, Nr 42, 20 October, p. V. 107.
Werking van langskrachten in den spoorwegbovenbouw. (600 woorden & fig.)

1928 691 (.73)
De Ingenieur, Nr 44, 3 November, p. B. 295.
DE BUSSY (M.). — Reisindrukken over de bereiding van beton in Amerika. (6 500 woorden & fig.)

1928 691
De Ingenieur, Nr 46, 17 November, p. B. 317.
Nieuwe onderzoekingen over de eigenschappen van beton door prof. O. Graf. (1 000 woorden.)

1928 625 .233
De Ingenieur, Nr 47, 24 November, p. E. 159.
VAN LIEMPT (J. A. M.). — Een nieuwe Philips' trein- en tramserielamp. (800 woorden en fig.)

De Locomotief. (Amsterdam.)

1928 656 .1 (.494) & 656 .2 (.494)
De Locomotief, Nr 42, 17 October. p. 330.
De autovervoervraagstuk in Zwitserland. (6 100 woorden.)

1928 625 .62 & 656 .1
De Locomotief, Nr 43, 24 October, p. 337.
Iets over tram en autobus en over de veiligheid dier vervoermiddelen. (1 100 woorden, 1 tabel.)

1928 669 .1
De Locomotief, Nr 45, 7 November, p. 354.
Een nieuwe methode voor het opsporen van onzichtbare breuken. (800 woorden & fig.)

1928 625 .24
De Locomotief, Nr 46, 14 November, p. 367.
Is de trustvorming in de wagonindustrie gunstig voor verbruikers? (2 000 woorden.)

Spoor- en Tramwegen. (Utrecht.)

1928 621 .138.2 & 721 .9
Spoor- en Tramwegen, Nr 2, 24 Juli, p. 36.
PLOMP (A.). — Kolenpark van in de fabriek vervaardigde beton-onderdeelen. (450 woorden & fig.)

1928 625 .232 (.43 + .492 + .494)
Spoor- en Tramwegen, Nr 3, 7 Augustus, p. 68.
De nieuwe rijtuigen van den « Rheingold »-Express. (800 woorden & fig.)

1928 656 .253
Spoor- en Tramwegen, Nr 3, 7 Augustus, p. 74.
Nieuwe signalen voor onbewaakte overwegen. (600 woorden & fig.)

1928 625 .232 (.492)
Spoor- en Tramwegen. Nr 4, 21 Augustus, p. 96.
BOLLEMAN KIJLSTRA (E.). — Nieuwe doorgangsrijtuigen der Nederlandsche Spoorwegen. (1 800 woorden & fig.)

1928 385 .4 (.43)
Spoor- en Tramwegen, Nr 4, 21 Augustus, p. 102.
OVERMANN. — **Eenheid in het Duitsche spoorwegbedrijf.** (1 700 woorden & fig.)

1928 385. (074 (.492)
Spoor- en Tramwegen, Nr 4, 21 Augustus, p. 105.
ASSELBERGHS (H.). — **Het Nederlandsch spoorwegmuseum.** (1 700 woorden & fig.)

1928 621 .133.7
Spoor- en Tramwegen, Nr 5, 4 September, p. 129.
ROSENTHAL (G. A.). — **De exhaust-injecteur.** (2 800 woorden & fig.)

1928 625 .113
Spoor- en Tramwegen, Nr 5, 4 September, p. 136.
BERGER (A. L.). — **Overgangsbogen.** (800 woorden, 1 tafereel & fig.)

1928 656 .222.5 (.492 + .92)
Spoor- en Tramwegen, Nr 6, 18 September, p. 159.
Indië-Holland trein. (1 600 woorden & fig.)

1928 621 .33 (.43)
Spoor- en tramwegen, Nr 6, 18 September, p. 166.
DE GELDER (G.). — **Rijksbanen en electrificatie.** (2 000 woorden & fig.)

1928 625 .232 (.71)
Spoor- en Tramwegen, Nr 6, 18 September, p. 173.
Nieuwe Canadeesche slaaprijtuigen. (200 woorden & fig.)

1928 385 .113 (.494)
Spoor- en Tramwegen, Nr 6, 18 September, p. 183.
De Zwitsersche Bondsspoorwegen in 1927. (1 000 woorden & fig.)

1928 656 .2
Spoor- en Tramwegen, Nr 10, 13 November, p. 285.
SIMON-THOMAS (W.). — **De economie van het bedrijf.** (11 000 woorden.)

1928 621 .13 & 621 .335
Spoor- en Tramwegen, Nr 10, 13 November, p. 291.
DE GELDER (G.). — **Reuzen-locomotieven.** (4 000 woorden, 3 tafereelen & fig.)

1928 621 .132.1 (.92)
Spoor- en Tramwegen, Nr 11, 26 November, p. 323.
DE BAAS (W. J. G.). — **De nieuwe 1 C + C-berglijn locomotieven Serie 1600 voor de Staatsspoorwegen op Java.** (1 600 woorden & fig.)

1928 656 .25 (.92)
Spoor- en Tramwegen, Nr 11, 26 November, p. 332.
BRUGMAN (H. P.). — **Beveiliging van het treinverkeer op de Staatsspoorwegen in Nederlandsch Indië.** (1 500 woorden & fig.)

Langue polonaise.

Inzynier Kolejowy. (Warszawa.)

1928 385. (09.3 (.438)
Inzynier Kolejowy, 1 Listopoda, str. 336.
EBERHARDT (J.). — **Koleje na Ziemiach Polskich w czasie Wojny Swiatowej.** (3 900 slowa.)

1928 385 .4 (.438)
Inzynier Kolejowy, 1 Listopoda, str. 377.
TUZ (A.). — **Unifacja eksploatacji.** (5 400 slowa.)

1928 625 .13 (.438)
Inzynier Kolejowy, 1 Listopoda, str. 382.
GUBRYNOWICZ (Z.). — **Zniszczenia mostów kolejowych w czasie wojny i ich odbudowa.** (4 100 slowa, 3 tablice & rys.)

1928 625 .1 (.438) & 656 .21 (.438)
Inzynier Kolejowy, 1 Listopoda, str. 395.
WASIUTYNSKI (A.). — **Przebudowa wezla kolejowego warszawskiego w dziesiecioleciu 1918-1928.** (10 000 slowa & rys.)

1928 621 .13 (.438) & 625 .2 (.438)
Inzynier Kolejowy, 1 Listopoda, str. 407.
WASILEWSKI (S.). — **Powstanie i rozwój taboru kolejowego w okresie 1918-1928 r.** (6 000 slowa, 6 tablice & rys.)

1928 621 .138.5 (.438) & 625 .26 (.438)
Inzynier Kolejowy, 1 Listopoda, str. 424.
PAWLOWSKI (A.). — **Stan i potrzeby gospodarki warsztatowej w latach 1919-1928.** (8 000 slowa, 3 tablice & rys.)

In Portuguese.

Boletim do Instituto de Engenharia. (S. Paulo.)

1928 62. (01
Boletim do Instituto de Engenharia, maio, p. 7.
MARSILLAC (J. A.). — **Momentos devidos aos deslocamentos horizontaes das extremidades dos pilares.** (500 palavras & fig.)

1928 625 .14 (01 (.81)
Boletim do Instituto de Engenharia, junho, p. 45.
da COSTA PINTO (J. B.). — **Estudo de superestructura da E. Ferrocarril da Central do Brasil.** (2 800 palavras, 1 cuadro & fig.)

Gazeta dos Caminhos de Ferro. (Lisboa.)

1928 621 .33 (.45)
Gazeta dos Cam. de ferro, nº 980, 16 de Out., p. 312.
Os caminhos de ferro na Italia e a sua electrificaçao. (1 600 palavras.)

1928 385 (.493
Gazeta dos Cam. de ferro, nº 981, 1º Nov., p. 326.
TRINDADE (E.). **A rêde rodoviária da Belgica.** (1 900 palavras.)

1928 656 .213 (.469
Gazeta dos Cam. de ferro, nº 982, 16 de Nov., p. 337.
DE SOUZA (J. F.). — **Os portos do Douro e Leixões e as suas ligaçoes ferroviarias.** (1 600 palavras & 5 cuadros.)

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[016 .385 (02]

I. — BOOKS.

In French.

1928 — 385. (09.1 (.4)

Carte des chemins de fer de l'Europe.

Paris. Secrétariat Général de l'Union internationale les chemins de fer, 24, rue Georges Bizet ou chez l'éditeur : M. Barrère, 21, rue du Bac. Carte en 9 couleurs, échelle de 1/1 500 000. composée par l'assemblage de 3 feuilles mesurant ensemble 2 m. × 2 m. 40. (Prix : 25 francs.)

1928 — 625 .12 (02

DAUTRY et GERVET.

Cours de chemins de fer. Première partie : Etudes et travaux d'infrastructure.

Vannes, Impr. Lafolye frères. Paris, Ecole spéciale des travaux publics, rue du Sommerard, rue Thénard et boulevard Saint-Germain. 13e édition. In-8°, 126 pages avec figures et planches.

1928 — 669. (02

LELONG (A.), ingénieur A. et M. et **MAIRY (E.)**, ingénieur A. et M.

Traité pratique de fonderie. Fonte. Fonte malléable. Acier. Alliages industriels.

Paris (6e), 15, rue des Saints-Pères; Liége. 1, quai de la Grande-Bretagne, Librairie polytechnique Ch. Béranger. 3e édition. 3 volumes in-8° jésus (180 × 280), contenant ensemble 1 252 pages, avec 708 fig. et 7 planches hors texte. (Prix : 350 francs.)

1928 — 34 & 38

POGUS (Georges R.), Docteur en droit, Secrétaire à la Direction du 1er arrondissement des Chemins de fer de l'Etat hellénique.

Droit de communication (en langue grecque), enseigné à l'Ecole polytechnique nationale de Grèce. Tome A. 1re édition.

Athènes, Imprimerie « Pyrsos », Société anonyme. 1 volume (16 × 24 cm.), de 32 pages.

1928 — 621 .116

ROSZAK (Ch.) et VÉRON (M.).

La production industrielle et l'utilisation mécanique de la vapeur d'eau à haute pression.

Paris, Chaleur et Industrie. In-4° (270 × 240), de 162 pages, avec 90 fig.

In German.

1928 — 621 .33

Fernmeldebetrieb an elektrischen Bahnen mit Gleichrichter-Speisung und in Fernmeldekabeln an Wechselstrombahnen.

Herausgegeben von W. Wechmann u. O. Michel.

Leipzig. Verlag von Johann Ambrosius Barth. 4°. 100 Seiten mit 159 Abb. (Preis : 7.50 Rm.)

1928 — 625 .6 (.43)

Handbuch der deutschen Strassenbahnen, Kleinbahnen und Privateisenbahnen sowie der angeschlossenen Kraftfahrbetriebe. — Bearbeitet von der Geschäftsstelle des Vereins deutscher Strassenbahnen, Kleinbahnen u. Privateisenbahnen E. V.

Leipzig. Verlag von Johann Ambrosius Barth. 4°, 304 Seiten mit eingedr. Kt. (Preis : 18 Rm.)

1928 — 669 .1 (02

Handbuch der Eisen- und Stahlgiesserei. Unter Mitarbeit zahlr. Fachgenossen herausgegeben von C. Geiger. **3. Band : Schmelzen, Nacharbeiten und Nebenbetriebe.**

Leipzig. Verlag von Johann Ambrosius Barth. 2., erweiterte Auflage. 4°, IX-747 Seiten, mit 967 Abb. im Text. (Preis, geb. : 68.50 Rm.)

1929 — 721 .9

KLEINLOGEL (A.).

Fertigkonstruktionen im Beton- und Eisenbetonbau.

Leipzig. Verlag von Johann Ambrosius Barth. Gr. 8°, IV-91 Seiten, mit 140 Textabb. (Preis, geh. : 8.60 Rm.)

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In English.

1928 621 .3

ARCHER (R. M.), B. Sc.

Commercial electrical measuring instruments. Direct and alternating current.

London. Sir Isaac Pitman & Sons, Ltd. (Price : 10 sh. 6 d. net.)

1928 625 .142.2 (.54)

BAILEY (W. A.), COLE (F. E.) and SEAMAN (L. N.).

Notes on half round sleepers of sal and teak. Technical Paper No. 269. One pamphlet (6 1/4 × 9 1/2 inches) of 29 pages with tables and figures.

Calcutta. Government of India. Central Publication Branch. (Price : As. 12 or 1 sh. 3 d.)

1928 385 .1 (.73)

BUREAU OF RAILWAY ECONOMICS (U. S. A.).

Economic situation in the Railway Industry. Summary of transportation conditions and performance of Class I railways from January 1 to October 1, 1928. reported to American Railway Association and issued as Miscellaneous series bulletin No. 46. 16 pages. Washington, D. C. Published by Bureau of Railway Economics. Apply.

1928 625 .4 (.42 + .44)

COLLARD (William).

Proposed London and Paris Railway : London and Paris in 2 hours 45 minutes, via a Channel tunnel and a proposed new Railway.

One vol. Crown quarto, 280 p. and map. London. P. S. King & Son Ltd., Publishers, Orchard House, 14, Great Smith Street, Westminster. (Price : Cloth. : 10 sh. 6 d.)

1928 621 .35

CRENNELL (J. T.) & LEA (F. M.).

Alkaline accumulators.

London. Longmans, Green & Company, Ltd. (Price : 10 sh. 6 d. net.)

1928 69 (.42)

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. **Report of the Building Research Board for the year 1927.**

London. His Majesty's Stationery Office. (Price : 3 sh. net.)

1928 385 .14 (.71 + .73) & 656 .23 (.71 + .73)

DUNCAN (C. S.) and BILO (E. F.).

Transportation charges in the United States and Canada. 49 pages. Maps.

Washington D. C. Published by Association of Railway Executives. Apply.

1928 691

IMPERIAL ECONOMIC COMMITTEE.

Report No. 10 : Timber.

London. H. M. Stationery Office. Cmd. 3175. 52 pages. (Price : 9 d. net.)

1928 665 .882. (

FOX (L. M.).

A handbook for oxy-acetylene welders. Second editic

London. Allen Liversidge Ltd., Victoria Stati House S. W. 1. (Price : 3 sh. 6 d. net.)

1928 385 .1 (.6

FRANKEL (S. Herbert), M. A., Ph. D.

The Railway Policy of South Africa.

Johannesburg, Hortors Ltd. London, S. W. 1, P. King & Son Ltd., 14, Great Smith Street (9 1/4 × inches). 367 pages. (Price : 15 sh.)

1928 6

FREEMAN (John R.).

Hydraulic laboratory practice : comprising a transl tion, revised to 1929, of Die Wasserbaulaboritori Europas. Including also descriptions of other Europe and American laboratories and notes on the theory experiments with models.

New York. The American Society of Mechanical E gineers. (9 × 12 inches); xxi + 866 pages; 989 hal tones and line cuts. (Price : $ 10.00.)

1928 5

HEARN (Colonel Sir Gordon).

Tacheograph for reduction of distance and tache graphs for difference of height for varying angles.

Calcutta, Thacker, Spink & Co., 3, Esplanade. (Price 3 sh.)

1928 355 (.7

HINES (Walker D.).

War history of American railroads.

New Haven, Conn. Yale University Press. 327 pag (Price : $ 3.75.)

1928 624. (02 & 69 (

HUNTER (Adam), M. Inst. C. E.

Bridge and structural engineer's handbook.

London S. W. 1. E. and F. N. Spon, Ltd., 57, Ha market. Second edition. (Price : 21 sh. net.)

1928 313 .385.113 (.7

INTERSTATE COMMERCE COMMISSION, BURE OF STATISTICS (U. S. A.).

Operating revenues and operating expenses by class service, Class I steam railways in the United Sta Year ended December 31, 1927. Statement No. 28 (First in the series). 34 pages.

Washington, D. C. Published by U. S. Governm Printing Office. (Price : 35 cents.)

1928 62. (

INSTITUTION OF CIVIL ENGINEERS (London).

Engineering abstracts from the current periodi literature of Engineering and applied Science publis outside the United Kingdom. New Series. — No. October 1928.

Published by the Institution with the co-operation other Engineering Societies in Great Britain and Dominions. 1 vol. (5 1/4 × 8 1/4 inches) of 232 pa with figures in the text.

1928 69. (02
LEANING (H. J.).

The supervision of building work, and the duties of a clerk of works.

London. Published by Messrs. Batsford, Ltd. (Price : 5 sh. net.)

1928 62. (01
MERRIMAN (Mansfield).

Strength of materials. Seventh edition revised by Thaddeus Merriman.

New York. John Wiley & Sons. Cloth 5 × 8 inches, 204 pages, tables. (Price : $ 1.75.)

1928 621 .4 (02

Oil engine power plant handbook. Edited by Julius Kuttner. Edition 4.

New York. National Trade Journals, Inc. Cloth. 8 × 11 inches, 288 pages, illust. (Price : $ 5.)

1928 385 .15 (.3)
SPLAWN (Walter M. W.).

Government ownership and operation of railroads. A survey of railway ownership and operation throughout the world, accompanied by 44 maps and numerous statistical tables.

New York City. Published by the Macmillan Co. 478 pages. (Price : $ 5.)

1928 691
TAYLOR (F. W.), THOMPSON (S. E.) & SMULSKI (E.).

Concrete, plain and reinforced : Vol. II. Theory and design of continuous beams, frames, building frames and arches.

New York. John Wiley & Sons. London. Chapman & Hall. (6 × 9 inches), 688 pages, 263 line cuts. (Price : $ 7.50.)

1929 621 .3 (02

The « Practical Engineer » electrical pocket book and diary, 1929. Edited by Conrad Arnold.

London, E. C. 4. The Oxford University Press, Amen House, Warwick-square. (Price : 2 sh. 6 d. net.)

1929 621. (02

The « Practical Engineer » mechanical pocket book and diary, 1929.

Edited by E. G. Beck.

London, E. C. 4. The Oxford University Press, Amen House, Warwick-square. (Price : 2 sh. 6 d. net.)

1928 621 .9
TIPPLE (E. W.).

Present-day developments in machine tools.

London. Offices of the Association of Engineering and Shipbuilding Draughtsmen. (Price : 2 sh. net.)

In Spanish.

1928 656 .21 (.460) & 725 .31 (.460)
COMPAÑIA DE LOS FERROCARRILES DE MADRID A ZARAGOZA Y A ALICANTE.

Proyecto de ampliación de la Estacion de Madrid-Atocha.

Madrid. In 4° (18 × 25 cm.). 20 paginas con fig. & planos fuera de texto.

[016 .385. (05]

II. — PERIODICALS.

In French.

Arts et Métiers. (Paris.)

1928 621 .4
rts et Métiers, décembre, p. 445.
ALLAIS (J.) et MATHIEU (M.). — L'augmentation u rendement dans les moteurs à explosion par l'utilisation de la détente prolongée. (1 000 mots & fig.)

1928 385. (01 (.66)
rts et Métiers, décembre, p. 452.
FARON (L.). — Transsaharien. Central Africain-hari-Oubangui. (2 500 mots & cartes.)

Bulletin de la Société d'encouragement pour l'industrie nationale. (Paris.)

1928 621 .133.7
ull. de la Soc. d'encourag. pour l'ind. nat., nov., p. 863.
LAVARDE (P.). — La pompe alimentaire Dabeg pour comotive. (900 mots & fig.)

Bulletin technique de la Suisse romande. (Vevey.)

1928 385 .14 (.43)
Bull. techn. de la Suisse romande, n° 26, 29 déc., p. 314.
SÉE (P.). — Les tarifs préférentiels de la Deutsche Reichsbahn et les ports de la mer du Nord. (800 mots.)

Bulletin des transports internationaux par chemins de fer. (Berne.)

1928 385. (09.1 (.439)
Bull. des transp. int. par ch. de fer, décembre, p. 576.
La situation du trafic des Chemins de fer royaux de l'Etat hongrois en 1927. (700 mots.)

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Bull. des transp. int. par ch. de fer, décembre, p. 582.
Statistique des Chemins de fer de l'Etat hellénique pour l'année 1925-1926. (350 mots & tableaux.)

Bulletin de l'Union internationale des chemins de fer. (Paris.)

1928 656 .1 & 656 .2
Bull. de l'Union intern. des ch. de fer, octobre, p. 361.
POURCEL (A.). — **Coopération entre chemins de fer et automobiles.** (3 200 mots.)

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Bull. de l'Union intern. des ch. de fer, octobre, p. 366.
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Bull. de l'Union intern. des ch. de fer, octobre, p. 378.
Le nouveau **système de deux classes de voitures** à voyageurs sur le réseau de la Compagnie des Chemins de fer allemands. (3 000 mots & 7 tableaux.)

1928 621 .133.1 (.42) & 621 .133.7 (.42)
Bull. de l'Union intern. des ch. de fer, octobre, p. 385.
L'express sans arrêt dit « Ecossais volant » entre Londres et Edimbourg. (1 300 mots & 1 tableau.)

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Chronique des transports, n° 23, 10 décembre, p. 21.
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1928 385. (01 (.64)
Chronique des transports, n° 23, 10 décembre, p. 26.
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Chronique des transports, n° 24, 25 décembre, p. 22.
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Le rail et l'air. (800 mots.)

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Génie civil. (Paris.)

1928 625 .13 (.44)
Génie Civil, n° 2417, 8 décembre, p. 550.
La reconstruction du Pont de l'Europe au-dessus des voies de la gare Saint-Lazare, à Paris. (1 500 mots & fig.)

1928 621 .335 (.47) & 621 .43 (.47)
Génie Civil, n° 2417, 8 décembre, p. 560.
Nouvelles **locomotives Diesel-électriques** pour les chemins de fer russes. (1 200 mots.)

1928 621 .335 (.54
Génie Civil, n° 2419, 22 décembre, p. 598.
DANTIN (Ch.). — Les **locomotives électriques** d
Great Indian Peninsula Railway. (5 000 mots & fig.)

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Génie Civil, n° 2419, 22 décembre, p. 610.
GOELZER (A.). — **La résistance élastique des joint soudés.** (2 700 mots & fig.)

1928 624 .
Génie Civil, n° 2419, 22 décembre, p. 614.
Les vibrations des ponts sous l'effet des charges rou lantes. (1 100 mots.)

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Génie Civil, n° 2420, 29 décembre, p. 625.
Le pont en béton de La Caille sur le torrent de Usses. (Haute-Savoie). (2 500 mots & fig.)

1928 654 (.43
Génie Civil, n° 2420, 29 décembre, p. 637.
Les progrès des **communications télégraphiques et télé phoniques,** en Allemagne. (2 000 mots & 2 cartes.)

1929 621 .31
Génie Civil, n° 2421, 5 janvier, p. 1.
TESZNER (S.). — Les tendances actuelles dans l **construction des postes de transformation à air libre** (4 000 mots & fig.)

1929 624 .51 (.73
Génie Civil, n° 2421, 5 janvier, p. 15.
CAUFOURIER (P.). — **Le pont suspendu** de Steu benville. (Etats-Unis). (1 500 mots & fig.)

Les Chemins de fer et les Tramways. (Paris.)

1928 385. (09.1 (.64
Les chemins de fer et les tramways, décembre, p. 25
CROZET (A.). — **Les chemins de fer au Maroc.** (1 50 mots & fig.)

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Les chemins de fer et les tramways, décembre, p. 26
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Les chemins de fer et les tramways, décembre, p. 26
Le **développement des voies ferrées** du Congo belg (1 000 mots.)

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SPIESS (E.). — **La locomotive auxiliaire.** (3 100 mot 3 tableaux & fig.)

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Les chemins de fer et les tramways, décembre, p. 2
Locomotive à essence des Chemins de fer fédéra (900 mots & fig.)

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Les chemins de fer et les tramways, décembre, p. 268.

SUTRA (P.). — **Enregistreur de manœuvres d'aiguillages et signaux (système « Bienvenue »).** (1 600 mots, 1 tableau & fig.)

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Les chemins de fer et les tramways, décembre, p. 272.

La soudure à l'arc dans la construction et la réparation. (1 000 mots.)

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Les chemins de fer et les tramways, décembre, p. 273.

RAUDNITZ (M.). — **Progrès dans la construction des appareils de pesage à voie ferrée.** (3 100 mots, 3 tableaux & fig.)

Le Correspondant des Techniciens et Professionnels des chemins de fer. (Saint-Dizier, Haute-Marne.)

1928 625 .172

Le Cor. des techn. et prof. des ch. de fer, 15 déc., p. 3.

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1928 725 .3

Le Cor. des techn. et prof. des ch. de fer, 15 déc., p. 4.

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1928 625 .251 & 656 .284

Le Cor. des techn. et prof. des ch. de fer, 15 déc., p. 13.

CAPITAN (H.). — **Incendie de wagons.** (2 000 mots.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

1928 625 .62

L'Ind. voies ferrées et transp. autom., novembre, p. 337.

ALBERT (L.). — **Note sur l'étude des lignes caténaires de contact destinées à l'exploitation des tramways.** (3 500 mots, 3 tableaux & fig.)

1928 656 .256.3 (.44)

L'Ind. voies ferrées et transp. autom., novembre, p. 344.

DUCROS (A.). — **La protection des voies uniques du réseau de la Société des Transports en Commun de la Région parisienne.** (2 100 mots, 1 tableau & fig.)

1928 625 .62

L'Ind. voies ferrées et transp. autom., novembre, p. 351.

BACQUEYRISSE. — **Voitures à un seul agent.** Rapport présenté au XXI[e] Congrès International (Rome, 1-12 mai 1928). (1 800 mots, 20 tableaux & fig.)

1928 625 .62

L'Ind. voies ferrées et transp. autom., décembre, p. 402.

VENTE. — **Principes rationnels de conduite d'un train muni d'un dispositif de récupération.** (1 200 mots & fig.)

La Science et la Vie. (Paris.)

1929 621 .31 (.431)

La Science et la Vie, janvier, p. 27.

MARCHAND (J.). — **La plus puissante centrale thermique du monde. L'usine thermoélectrique de Klingenberg, près de Berlin, produira 500 000 kw. (680 000 ch.).** (1 800 mots & fig.)

Revue C. F. F. (Berne).

1928 625 .232 (.494)

Revue C. F. F., n° 11, 15 novembre, p. 35.

Les voitures à malades des C. F. F. (600 mots & fig.)

Revue de l'École polytechnique. (Bruxelles).

1928 62. (01 & 721 .4

Revue de l'Ecole polytechnique, novembre, p. 51.

GYSEN (E.). — **Etude de l'arc doublement encastré.** (3 300 mots & fig.)

Revue générale des chemins de fer. (Paris.)

1928 625 .1 (.44)

Revue gén. des chemins de fer, décembre, p. 577.

Inauguration du chemin de fer de Rothau à Saales et à Saint-Dié. (1 800 mots, 2 tableaux & fig.)

1928 624. (01 (.44)

Revue gén. des chemins de fer, décembre, p. 584.

LÉVI (R.). — **Note sur le Règlement du 10 mai 1927 pour le calcul et les épreuves des ponts métalliques.** (3 400 mots.)

1928 625 .245 (.44) & 665 .882 (.44)

Revue gén. des chemins de fer, décembre, p. 590.

PORTAL. — **Le wagon-atelier de soudure de la Compagnie des Chemins de fer de Paris à Lyon et à la Méditerranée.** (1 300 mots & fig.)

1928 385. (06.3

Revue gén. des chemins de fer, décembre, p. 595.

Les trois grandes conférences internationales de 1927 et les questions de chemins de fer. (3 500 mots.)

1928 385 .113 (.495)

Revue gén. des chemins de fer, décembre, p. 601.

Les Chemins de fer de l'Etat hellénique durant l'exercice 1926-1927. (600 mots & 1 tableau.)

1928 385 .113 (.489)

Revue gén. des chemins de fer, décembre, p. 606.

Les Chemins de fer de l'Etat danois pendant l'exercice 1926-1927. (750 mots & 2 tableaux.)

1928 385 .113 (.481)

Revue gén. des chemins de fer, décembre, p. 608.

Les Chemins de fer de l'Etat norvégien pendant l'exercice 1925-1926. (500 mots & 1 tableau.)

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Revue gén. des chemins de fer, décembre, p. 610.
Les **chemins de fer suédois** en 1926. (1 500 mots.)

1928 625 .14 (.43)
Revue gén. des chemins de fer, décembre, p. 615.
Superstructure des Chemins de fer allemands. (1 000 mots & fig.)

Revue Générale des Transports Automobiles. (Paris.)

1928 656 .1 & 656 .2
Revue gén. des transp. autom., juillet-août, p. 102.
TEUBNER. — **Collaboration entre chemin de fer et automobile.** (1 900 mots.)

1928 656 .1 & 656 .2
Revue gén. des transp. autom., septembre, p. 119.
Un nouveau mode de **collaboration du chemin de fer et de l'automobile.** (1 000 mots.)

Revue universelle des mines, de la métallurgie, des travaux publics, des sciences et des arts appliqués à l'industrie. (Liége.)

1929 621 .4
Revue universelle des mines, n° 1, 1er janvier, p. 2.
DUCHESNE (A.). — Etude thermodynamique et expérimentale complète d'un **moteur à gaz.** (5 800 mots, tableaux & fig.)

In German.

Elektrotechnische Zeitschrift. (Berlin.)

1928 625 .4 (.42)
Elektrotechnische Zeitschrift, Heft 51, 20 Dez., S. 1837.
GRETSCH (R.). — Die elektrische **Post-Röhrenbahn** in London. (2 400 Wörter & Abb.)

1929 621 .3 (09 & 621 .33 (09
Elektrotechnische Zeitschrift, Heft 1, 3 Jan., S. 10.
ZEHME (E. C.). — **Fünfzig Jahre elektrische Bahnen und Antriebe.** (4 500 Wörter.)

1929 621 .335
Elektrotechnische Zeitschrift, Heft 1, 3 Jan., S. 23.
Stufenschalter für **Einphasenlokomotiven.** (600 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1928 385 .113 (.43)
Glasers Annalen, Heft 10, 15. November, S. 123.
Aus dem **Geschäftsbericht der Deutschen Reichsbahn-Gesellschaft** über das 3. Geschäftsjahr. (2 600 Wörter & 1 Tabelle.)

1928 621 .131.3
Glasers Annalen, Heft 11, 1. Dezember, S. 137.
NORDMANN (H.). — Neue Versuchsmethoden und Versuchsergebnisse auf dem Gebiet der **Dampflokomotive.** (6 000 Wörter, 2 Tabellen & Abb.)

1928 621 .335 & 621 .43
Glasers Annalen, Heft 11, 1 Dezember, S. 146.
GERSTMEYER (M.). — Die **Diesel-Lokomotive** und die moderne **Zugförderung.** (5 800 Wörter & Abb.)

1928 621 .133.1
Glasers Annalen, Heft 11, 1 Dezember, S. 157.
VOGT. — Die **Brennstoffwirtschaft einiger Bahnverwaltungen** nach den Berichten auf der Brennstofftagung der Weltkraftkonferenz. (2 800 Wörter & 2 Tabellen.)

1928 621 .138.3 (.43)
Glasers Annalen, Heft 12, 15. Dezember, S. 163.
PABST. — Eine neuartige **Lokomotivauswaschanlage.** (3 000 Wörter & Abb.)

1928 656 .254
Glasers Annalen, Heft 12, 15. Dezember, S. 166.
ZEULMANN. — **Selbsttätige Warnsignaleinrichtungen** für Strassenfahrzeuge an schienengleichen Eisenbahnwegübergängen. (3 200 Wörter & Abb.)

1928 625 .216 & 656 .282
Glasers Annalen, Heft 12, 15. Dezember, S. 178.
Mittelpuffersteifkupplung und **Eisenbahnkatastrophen.** (1 600 Wörter & Abb.)

In English.

Bengal-Nagpur Railway Magazine. (Calcutta.)

1928 656 .1 & 656 .2
Bengal-Nagpur Railway Magazine, November, p. 21.
Road versus rail transport. (1 200 words & fig.)

Bulletin American Railway Engineering Association. (Chicago.)

1928 625 .1 (06 (08 (.73)
Bull. Amer. Ry. Eng. Assᵒⁿ, No. 309, September.
Past-Presidents' Bulletin made up of contributions from the Past-Presidents of the Association.

Page 3 : Historical notes, by Geo. W. Kittredge; p. 6 : A travelogue, by Hunter McDonald; p. 10 : Fundamental education for industrial enterprise; p. 13 : Early history of « The American Railway Engineering Association », by L. C. Fritch; p. 27 : Progress in the greatest half-century, 1878-1928, and some considerations of a proper beginning of the next one, by Chas. S. Churchill; p. 32 : Federal valuation of railroads, by Edwin F. Wendt; p. 48 : Is there a road to plenty? by John G. Sullivan; p. 52 : Requisites of an Engineer, by C. A. Morse; p. 60 : A suggestion, by Earl Stimson; p. 63 : The A. R. E. A. — Its past, present and future, by H. R. Safford; p. 65 : What it is all about, by J. F. Campbell; p. 68 : The value of Judgment, by E. H. Lee.

1928 621 .139 (08 (.73), 625 .18 (08 (.73) & 625 .27 (08 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 310, October, p. 65.
Report of Special Committee on **standardization.** (24 000 words & tables.)

1928 621 .133.7 (08 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 310, October, p. 123.
Report of Committee XIII. — **Water Service** and **sanitation.** (30 000 words, tables & fig.)

1928 625 .12 (08 (.73) & 625 .14 (08 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 310, October, p. 211.
Report of Committee I. — **Roadway.** (12 500 words & tables.)

1928 625 .141. (08 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 310, October, p. 245.
Report of Committee II. — **Ballast.** (6 000 words & fig.)

Electric Railway Journal. (New-York.)

1928 621 .33 (.73)
Electric Railway Journal, No. 22, December 1, p. 948.
Bay Ridge Electrification Completed. (1 800 words & fig.)

1928 725 .33 (.73)
Electric Railway Journal, No. 22, December 1, p. 953.
New Philadelphia Rapid Transit Co. **bus shop.** (3 000 words & fig.)

1928 621 .33 (.73)
Electric Railway Journal, No. 23, December 8, p. 991.
« **Narrow Gage** » **electrified** for economy. (2 500 words, 1 table & fig.)

1928 388
Electric Railway Journal, No. 25, December 22, p. 1070.
Analysis made of **factors affecting riding habit** in **large cities.** (2 300 words, 7 tables & fig.)

1928 385 .517.6 (.73)
Electric Railway Journal, No. 25, December 22, p. 1083.
Interborough cares for **medical and surgical needs of employees.** (800 words, 1 table & fig.)

1928 625 .172 (.73)
Electric Railway Journal, No. 25, December 22, p. 1086.
Weed fighting in California. (1 000 words & fig.)

Engineer. (London.)

1928 621 .165 (.43)
Engineer, No. 3804, December 7, p. 620.
The **turbines** at the Klingenberg power station. (18 000 words, 2 tables & fig.)

1928 621 .137.1
Engineer, No. 3804, December 7, p. 622.
DENDY MARSHALL (C. F.). — **The outlook from a locomotive.** (1 000 words & fig.)

1928 669 .1
Engineer, No. 3804, December 7, p. 637.
The **case hardening of steels** by nitrogen. (2 500 words, 4 tables & fig.)

1928 625 .236 (.44)
Engineer, No. 3805, December 14, p. 652.
BURTON ALEXANDER (J. T.). — **Plant for cleaning passenger trains,** Eastern Railway, France. (2 800 words & fig.)

1928 621 .132.3 (.494) & 621 .134.3 (.494)
Engineer, No. 3805, December 14, p. 655.
An **850-lb. pressure passenger locomotive.** (2 500 words, 1 table & fig.)

1928 691
Engineer, No. 3805, December 14, p. 664.
The corrosive attack of moorland water on **concrete.** (3 000 words, 7 tables & fig.)

1928 625 .142.3 (.42)
Engineer, No. 3805, December 14, p. 666.
Steel sleepers. The Sandberg type. (1 000 words & fig.)

1928 62. (01 & 669
Engineer, No. 3806, December 21, p. 676.
SWIFT (H. W.). — **Thin cylinders** of non-circular section. (1 700 words & fig.)

1928 621 .31 (.42)
Engineer, No. 3806, December 21, p. 680.
Mercury vapour rectifiers at Shoreditch. (1 600 words & fig.)

1928 621 .132.5 (.86)
Engineer, No. 3806, December 21, p. 681.
Three cylinder **narrow-gauge locomotives** for Colombia. (2 000 words, 1 table & fig.)

1928 62. (01 & 669
Engineer, No. 3806, December 21, p. 692.
HERBERT (E. G.). — Report on **machinability** (4 700 words, 1 table & fig.)

1928 62. (01 & 669 .1
Engineer, No. 3807, December 28, p. 707.
BATSON (R. G.). — **Strength of low carbon steels** at high temperatures. (1 900 words, 6 tables & fig.)

1928 621 .133.1 (.42 + .73)
Engineer, No. 3807, December 28, p. 716.
Locomotive performance. (700 words.)

1928 656 .212 .6 (.42)
Engineer, No. 3807, December 28, p. 720.
A rotary **truck tippler.** (1 100 words & fig.)

1928 621 .392 & 665 .882
The Metallurgist, p. 178, Sup. Eng., No. 3807, Dec. 28.
Welding. (800 words.)

1928 62. (01 & 621 .392
The Metallurgist, p. 180, Sup. Eng., No. 3807, Dec. 28.
The strength of welds at elevated temperatures. (700 words & fig.)

1928 669
The Metallurgist, p. 181, Sup. Eng., No. 3807, Dec. 28.
Distortion in case-hardening. (700 words & 1 table.)

1928 62. (01 & 669
The Metallurgist, p. 186, Sup. Eng., No. 3807, Dec. 28.
The physical significance of the yield point. (1 200 words.)

1928 62. (01 & 669
The Metallurgist, p. 191, Sup. Eng., No. 3807, Dec. 28.
Further studies of the yield point. (1 300 words.)

1929 621 .3 (.42)
Engineer, No. 3808, January 4, p. 10.
Electrical engineering in 1928. (3 400 words, 1 table & fig.)

1929 621 .132.1 (.42)
Engineer, No. 3808, January 4, p. 17.
Locomotives of 1928. (4 700 words, 1 table & fig.)

Engineering. (London.)

1928 621 .132.6 (.42)
Engineering, No. 3283, December 14, p. 744.
2-6-4 type passenger tank locomotive for the London Midland and Scottish Railway. (700 words & fig.)

1928 625 .4 (.42) & 656 .211 (.42)
Engineering, No. 3283, December 14, p. 754.
The reconstruction of the Piccadilly Circus Tube Railway Station, London. (1 200 words & fig.)

1928 621 .31 (.42)
Engineering, No. 3283, December 14, p. 759.
The Barton power station of the Manchester Corporation. (1 800 words & fig.)

1928 669
Engineering, No. 3284, December 21, p. 789.
HERBERT (E. G.). — Machinability. (5 200 words, 1 table & fig.)

1928 691
Engineering, No. 3284, December 21, p. 793.
Shutterless reinforced-concrete construction. (900 words & fig.)

1928 .691
Engineering, No. 3285, December 28, p. 798.
Coal residues in concrete. (1 700 words.)

1928 621 .4
Engineering, No. 3285, December 28, p. 805.
Double-acting high-speed internal-combustion engine. (1 900 words & fig.)

1928 621 .133.1
Engineering, No. 3285, December 28, p. 811.
The sampling and analysis of coal. (1 500 words.)

1928 621 .8
Engineering, No. 3285, December 28, p. 816.
Power transmission by belts. (2 600 words.)

1929 621 .31 (.73)
Engineering, No. 3286, January 4, p. 1.
160 000-kw. steam turbo-generator for the Hell Gate power station, New York. (5 700 words & fig.)

1929 621 .132.3 (.42)
Engineering, No. 3286, January 4, p. 23.
4-6-0 type locomotives for the Great Western Railway. (300 words & fig.)

1929 669 .1
Engineering, No. 3286, January 4, p. 25.
HALER (P. J.). — The quenching of steel. (2 200 words, 2 tables & fig.)

Engineering News-Record. (New-York.)

1928 624 .1 (.71 + .73)
Engineering News-Record, No. 23, December 6, p. 830.
PROCTOR (Edward A.). — Foundation construction for the Detroit River suspension bridge. (3 500 words & fig.)

1928 691
Engineering News-Record, No. 23, December 6, p. 835.
New preservative (zinc meta-arsenite) adds to structural possibilities of wood. (600 words.)

1928 625 .13 (.73)
Engineering News-Record, No. 23, December 6, p. 843.
Erecting 70-ton girders with a derrick car. (700 words & fig.)

1928 625 .1 (.73)
Engineering News-Record, No. 23, December 6, p. 849.
Texas Railway completes new through route. (900 words & fig.)

1928 721 .1 (.73)
Engineering News-Record, No. 24, December 13, p. 870.
BOWEN (S. W.). — Sinking open concrete caissons for foundations. (2 000 words & fig.)

1928 624 .62 (.73)
Engineering News-Record, No. 24, December 13, p. 873.
Design of the 1 675-ft. Kill van Kull steel-arch bridge. (4 300 words & fig.)

1928 624 .7 (.73)
Engineering News-Record, No. 24, December 13, p. 877.
Concrete-deck timber trestles on the Norfolk & Western R.-R. (1 900 words & fig.)

1928 385. (09.2 (.42)
Engineering News-Record, No. 25, December 20, p. 906.
LOWE-BROWN (W. L.). — **Pioneers of civil engineering.** (4 800 words & fig.)

1928 624 .63 (.73)
Engineering News-Record, No. 25, December 20, p. 919.
BURKEY (J. R.). — Features of an **open-spandrel arch viaduct.** (3 500 words & fig.)

1928 625 .13 (.73)
Engineering News-Record, No. 25, December 20, p. 942.
SINGSTAD (O.). — A year's operating experience with the Holland vehicular **tunnel.** (7 700 words & fig.)

1928 624 .1 (.73) & 691 (.73)
Engineering News-Record, No. 25, December 20, p. 955.
FARMER (H. G.). — 50-ft. **concrete bridge piles** driven six days after pouring. (600 words & fig.)

1928 624 .8 (.73)
Engineering News-Record, No. 25, December 20, p. 962.
HOWARD (E. E.). — **Lift span** to replace Duluth ferry bridge. (1 800 words & fig.)

Great Western Railway Magazine. (London.)

1929 385. (09.1 (.42)
Great Western Ry. Magazine, January, p. 5.
The past year's work in the principal departments (Great Western Ry., Great Britain). (16 000 words.)

Institution of Engineers, Australia. (Sydney.)

1928 621 .332
Instit. of Engineers, Australia, Bull. 31 October, p. 362.
LONGFIELD (C. M.). — Some recent developments in the **design and protection of transmission and distribution circuits.** (4 500 words & fig.)

Journal of the Institute of Transport. (London.)

1928 656 .1 (.42) & 656 .224 (.42)
Journal of the Institute of Transport, Dec., p. 72.
LANE (F.). — **Motor transport** in the British postal service. (11 500 words & fig.)

1928 388 (.42)
Journal of the Institute of Transport, Dec., p. 89.
HOWDEN (G. B.). — **High speed transport.** (6 500 words.)

1928 656 (.42)
Journal of the Institute of Transport, Dec., p. 99.
CAVENEY (H. J.). — **Newspaper transport.** (1 100 words.)

1928 656 .254 (.82)
Journal of the Institute of Transport, Dec., p. 101.
GODDARD (P.). — **Traffic control** on the Central Argentine Railway. (3 800 words.)

Locomotive Railway Carriage & Wagon Review. (London.)

1928 621 .132 (.54)
Loc. Ry. Carriage & Wagon Review, December, p. 377.
Standard locomotives for the Indian State Railways, broad and metre gauge. (1 200 words & fig.)

1928 625 .24 (.43)
Loc. Ry. Carriage & Wagon Review, December, p. 401.
High-capacity wagons for the German Railways. (1 400 words, 1 table & fig.)

Mechanical Engineering. (New-York.)

1928 621 .331
Mechanical Engineering, December, Sect. one, p. 914.
CHRISTIE (A. G.). — The peak load problems in **steam power stations.** (5 000 words, 1 table & fig.)

1928 621 .132.3 (.43) & 621 .134.3 (.43)
Mechanical Engineering, December, Sect. one, p. 921.
WAGNER (R. P.). — The **Schmidt high-pressure locomotive** of the German State Railway Company. (3 200 words & fig.)

1928 621 .86
Mechanical Engineering, December, Sect. one, p. 937.
CROCKETT (C. B.). — Economic aspects of the **shipment of materials** on skid platforms. (2 300 words & fig.)

1929 621. (08 (.73)
Mechanical Engineering, January, Sect. one, p. 13.
ELLMER (W.). — Progress in **railroad mechanical engineering.** (3 200 words.)

1929 621 .7 (08 (.73)
Mechanical Engineering, January, Sect. one, p. 16.
MORROW (L. C.). — Progress in **machine-shop practice.** (3 000 words.)

1929 621 .8 (08 (.73)
Mechanical Engineering, January, Sect. one, p. 26.
Progress in **materials handling.** (2 700 words & fig.)

1929 621 .4 (08 (.73)
Mechanical Engineering, January, Sect. one, p. 31.
KUTTNER (J.). — Progress in **oil- and gas- power engineering.** (4 000 words.)

1929 621 .2 (08 (.73) & 627. (08 (.73)
Mechanical Engineering, January, Sect. one, p. 35.
THOMAS (R. L.). — Progress in **hydraulics.** (3 500 words.)

1929 621 .1 (08 (.73)
Mechanical Engineering, January, Sect. one, p. 39.
ALDEN (V. E.). — Progress in **steam-power engineering.** (1 900 words.)

1929 669 .1 (08 (.73)
Mechanical Engineering, January, Sect. one, p. 49.
SNYDER (G. T.). — Progress in iron and steel. (3 000 words.)

1929 621 .116. (08 (.73)
Mechanical Engineering, January, Sect. one, p. 61.
WARD (J. T.). — Progress in fuel utilization in 1928. (3 000 words.)

1929 621 .116
Mechanical Engineering, January, Sect. one, p. 65.
Recent developments in the **utilization of bituminous coal.** (5 000 words.)

Modern Transport. (London.)

1928 625 .13 (.42)
Modern Transport, No. 507, December 1, p. 3.
Widening between Longbridge and Barnt Green, London Midland and Scottish Railway **(Opening out of Cofton Tunnel).** (1 600 words & fig.)

1928 625 .215 (.42)
Modern Transport, No. 507, December 1, p. 10.
Railway rolling stock. Improvements in **bogie design.** (1 200 words & fig.)

1928 656. (.42 + .73)
Modern Transport, No. 507, December 1, p. 16.
BEAUMONT (E. G. E.). — **Co-operation in transport.** Comparison of British and American methods. (1 000 words.)

1928 656 .211 (.45) & 725 .31 (.45)
Modern Transport, No. 508, December 8, p. 3.
Notable Italian railway development **(New passenger station, locomotive depot and marshalling yard** under construction at Milan). (2 400 words & fig.)

1928 725 .31
Modern Transport, No. 508, December 8, p. 7.
Railway **station architecture.** (Fig.)

1928 347 .763 (.42)
Modern Transport, No. 508, December 8, p. 9.
Bills in Parliament. — No. 1. Proposals of the Railway Companies. (1 100 words.)

1928 625 .245 (.42)
Modern Transport, No. 508, December 8, p. 13.
Rail carriage of grain. Special **hopper vans** for L. M. S. R. (800 words & fig.)

1928 621 .13 (0
Modern Transport, No. 508, December 8, p. 15.
ANDERSON (D. S.). — **Future development of the locomotive.** Turbines, condensing, reciprocators, water tube boilers and pulverized fuel. (1 400 words.)

1928 625 .4 (.42 + .44)
Modern Transport, No. 508, December 8, p. 18.
High-speed broad-gauge railway under the Channel. (2 200 words & 1 map.)

1928 656 .1 & 656 .2
Modern Transport, No. 508, December 8, p. 22.
Road vehicles adapted for rail service. New device for Fageol twin coach. (1 500 words & fig.)

1928 621 .133.1
Modern Transport, No. 509, December 15, p. 9.
Substitutes for petrol. Gas producers and Diesel engines for road vehicles. (1 400 words.)

1928 385. (09.1 (.54)
Modern Transport. No. 509, December 15, p. 10.
Railway progress in India. (1 300 words & fig.)

1928 621 .335 (.71) & 621 .4 (.71)
Modern Transport, No. 509, December 15, p. 13.
Oil-electric locomotives in Canada. New 2 600 H. P. units for Canadian National Railways. (1 000 words & fig.)

1928 656 .227 (.42)
Modern Transport, No. 510, December 22, p. 9.
A special load by rail (stator weighing 105 tons). (1 000 words & fig.)

1928 385 .3 (.42)
Modern Transport, No. 510, December 22, p. 10.
Railways and the Transport Commission. Case for the Companies. (2 500 words.)

1928 385. (09 (.498)
Modern Transport, No. 510, December 29, p. 3.
Railways of Rumania. Important works in hand or projected. (1 200 words & fig.)

Proceedings, American Society of Civil Engineers. (New-York.)

1928 526
Proceed. Amer. Soc. Civil Eng., December, p. 2639.
RAYNER (W. H.). — **Specifications for transit traversing and stadia leveling.** (6 000 words, 4 tables & fig.)

Proceedings, Institution of Civil Engineers. (London.)

1927-1928 62. (01 & 691
Proceed., Institut. of Civil Eng., Part 1, Vol. 225, p. 27
FABER (O.). — **Plastic yield, shrinkage, and other problems of concrete, and their effect on design.** (38 000 words, 10 tables & fig.)

1927-1928 625 .13 (.42)
Proceed., Institut. of Civil Eng., Part 1, Vol. 225, p. 221
TURNER (K. B.) and WALSH (R. E.). — **The reconstruction of two railway swing bridges** between Ipswich and Great Yarmouth. (16 000 words, 2 tables & fig.)

1927-1928 **621 .43**
Proceed., Institut. of Civil Eng., Part 1, Vol. 225, p. 265.
CLERK (Sir Dugald). — Standards of thermal efficiency for **internal combustion motors.** (20 000 words, 5 tables & fig.)

1927-1928 **624 .32 (.71)**
Proceed., Institut. of Civil Eng., Part 1, Vol. 225, p. 321.
SWAN (A. D.). — **Railway and vehicular bridge** across Vancouver Harbour, B. C. (Canada). (14 000 words.)

1928 **627**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 57.
PARKER (Geoffrey). — The construction of **lock-foundations by the gravity method.** (2 400 words & fig.)

1928 **721 .1**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 58.
VIVIAN (A. C.). — A theory of **earth-pressures.** (2 600 words & fig.)

1928 **698**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 59.
MARKWICK (A. H. D.). — Protective **paints.** (1 400 words, 2 tables & fig.)

1928 **614 .4 (.62)**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 61.
PINSON (A. O. W. D.). — **Anti-malarial measures** in Egypt since 1916. (5 300 words & fig.)

1928 **624 .1 & 721 .1**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 62.
NICHOLSON (J. H.). — **Pile formulas.** (1 100 words, 1 table & fig.)

1928 **62. (01 & 691**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 63.
WILLS (L. G.). — Concentrated **loads** on a **reinforced-concrete slab.** (2 200 words & fig.)

1928 **625 .14**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 64.
INGLIS (R. A.). — The proportioning of **railway-track components** from an economic standpoint. (7 500 words, 1 table & fig.)

1928 **624 .61 (.42)**
Proceed. Inst. of Civ. Eng., selected eng.-paper, No. 66.
WARD (A. W.). — The reconstruction of the English **bridge** over the River Severn at Shrewsbury. (4 500 words & fig.)

1928 **656 .212.6**
Proceed. Inst. of Civ. Eng., Vernon-Harcourt lecture 1927-1928.
REED (Henry Ashman). — **Appliances for handling goods** in ports and docks. (8 800 words & fig.)

Railway Age. (New-York.)

1928 **625 .1 (.73)**
Railway Age, No. 22, December 1, p. 1073.
Fort Worth & Denver South Plains **completes 207-mile line** in Texas. (2 300 words, 1 map & fig.)

1928 **385 .14 (.71 + .73) & 656 .23 (.71 + .73)**
Railway Age, No. 22. December 1, p. 1078.
Transportation charges in United States and Canada. (1 200 words & fig.)

1928 **625 .245 (.71)**
Railway Age, No. 22, December 1, p. 1079.
Canadian Pacific builds new **dynamometer car.** (2 900 words & fig.)

1928 **621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)**
Railway Age, No. 22, December 1, p. 1089.
Purchasing Officers discuss **trade practices.** (1 200 words & fig.)

1928 **385 .3 (.73)**
Railway Age, No. 22, December 1, p. 1095.
Accounting hearings closed (I. C. C.). (4 800 words.)

1928 **621 .33 (.73)**
Railway Age, No. 22, December 1, p. 1099.
The Bay Ridge **electric traction** installation. (2 000 words & fig.)

1928 **385 .21 (.73)**
Railway Age, No. 23, December 8, p. 1119.
Cost of transportation by water and by rail. (1 500 words.)

1928 **624 .2 (.73)**
Railway Age, No. 23, December 8, p. 1122.
LANG (P. G.) Jr. — New **bridges** carry E-90 loading. (1 500 words & fig.)

1928 **621 .335 (.73) & 621 .4 (.73)**
Railway Age, No. 23, December 8, p. 1125.
Canadian National's new 2660-Hp. **oil-electric locomotive.** (2 300 words & fig.)

1928 **385. (072 (.73)**
Railway Age, No. 23. December 8, p. 1129.
BROWNE (H. D.). — North Western a **pioneer in research.** (2 300 words & fig.)

1928 **656**
Railway Age, No. 23, December 8, p. 1132.
LISMAN (F. J.). — **Whither are the railroads drifting?** (2 800 words.)

1928 **656 .254 (.73)**
Railway Age, No. 23, December 8, p. 1135.
Flashing-light crossing signals save money for Wabash. (1 200 words & fig.)

1928 **625 .2 (01 & 625 .22**
Railway Age, No. 23. December 8, p. 1137.
SYMINGTON (T. H.). — **Freight car truck action** in curves. (2 000 words.)

1928 **385 .4 (.73) & 656 .253 (.73)**
Railway Age, No. 23, December 8, p. 1139.
No **train-control installations ordered.** (4 300 words & 2 tables.)

1928 385 .4 (06 (08 (.73)
Railway Age, No. 23, December 8, p. 1143.
I. C. C. annual report. (3 100 words & 3 tables.)

1928 621 .138.5 (.73), 625 .18 (.73) & 625 .26 (.73)
Railway Age, No. 24, December 15, p. 1170.
KIRK (J. C.). — Rock Island gets results in material handling. (2 500 words & fig.)

1928 621 .133.7 (.73)
Railway Age, No. 24, December 15, p. 1175.
New Haven solves interesting power plant water supply problem. (3 500 words & fig.)

1928 621 .132.3 (.73) & 621 .132.5 (.73)
Railway Age, No. 24, December 15, p. 1181.
Southern Pacific simple articulated locomotive. (2 300 words, 2 tables & fig.)

1928 657
Railway Age, No. 24, December 15, p. 1187.
HEISS (C. A.). — The American Telephone & Telegraph Company's budget system. (3 100 words.)

1928 656 .1 (.73) & 656 .2 (.73)
Railway Age, No. 24, December 15, p. 1191.
Adjusting operations to declining passenger traffic. (2 000 words, 2 tables & fig.)

1928 656 .223.2 (.73)
Railway Age, No. 25, December 22, Section one, p. 1216.
NELSON (C. J.). — Classified car inspection needed. (1 800 words & fig.)

1928 625 .175 (.73)
Railway Age, No. 25, December 22, Section one, p. 1218.
New heavy-duty motor car. (500 words & fig.)

1928 625 .232 (.71)
Railway Age, No. 25, December 22, Section one, p. 1219.
Cafe-Parlor cars for the Canadian National. (1 000 words & fig.)

1928 656
Railway Age, No. 25, December 22, Section one, p. 1221.
Co-ordination of air and rail transportation. (2 800 words.)

1928 385 .5 (.73)
Railway Age, No. 25, December 22, Section one, p. 1225.
MORSE (Ch. A.). — A needed reform in conducting maintenance of way. (1 800 words & fig.)

1928 621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)
Railway Age, No. 25, December 22, Section one, p. 1227.
CURTIS (D. C.). — Budgets modernize railway purchasing. (2 000 words & fig.)

1928 614 .8 (.73) & 656 .28 (01 (.73)
Railway Age, No. 25, December 22, Section one, p. 1231.
PARMELEE (J. H.). — Progress in accident prevention. (1 100 words.)

1928 656 .211 (.73)
Railway Age, No. 25, December 22, Section one, p. 1232.
St. Louis Union Station facilities to be enlarged. (350 words & fig.)

1928 385 .1 (.73) & 385 .3 (.73)
Railway Age, No. 25, December 22, Section one, p. 1233.
Supreme Court asked to review I. C. C. valuation methods. (6 500 words.)

1928 656 .244 (.73)
Railway Age, No. 25, December 22, Section one, p. 1239.
MARTIN (J. W.), Jr. — Solid carbon dioxide for refrigerating railroad cars. (2 600 words.)

1928 656 .1 (.73)
Railway Age, No. 25, December 22, Section two, p. 1261.
TRAVIS (W. E.). — Long haul transportation by motor coach. (3 000 words & fig.)

1928 656 .1 (.73) & 656 .2 (.73)
Railway Age, No. 25, December 22, Section two, p. 1269.
Missouri Pacific and Cotton Belt announce plans. (1 300 words, 2 tables & fig.)

1928 656 .261 (.73)
Railway Age, No. 25, December 22, Section two, p. 1275.
Report on freight trucking in New York. (6 400 words & 1 table.)

Railway Engineer. (London.)

1928 656 .281 (.42)
Railway Engineer, December, p. 435.
Some recent derailments. (1 100 words.)

1928 625 .1 (.42)
Railway Engineer, December, p. 437.
An important railway reconstruction. — Improvements at Scunthorpe and Frodingham, London & North Eastern Railway. (2 700 words & fig.)

1928 621 .133.1
Railway Engineer, December, p. 447.
FOWLER (Sir Henry). — Fuel conservation in locomotive practice. (1 200 words.)

1928 621 .133.7 (.42)
Railway Engineer, December, p. 457.
Locomotive feed-water heating on the Great Southern Railways of Ireland. (1 000 words & fig.)

1928 621 .33 (.54)
Railway Engineer, December, p. 461.
Bombay suburban electrification. (2 200 words & fig.)

1928 621 .133.1 (.42)
Railway Engineer, December, p. 463.
CLUBLEY ARMSTRONG (J.). — Pulverised fuel locomotives. (1 600 words.)

1928 621 .94 (.42)
Railway Engineer, December, p. 465.
A new railway wheel lathe. (2 400 words & fig.)

1928 621 .134.2 (.42)
Railway Engineer, December, p. 468.
Noteworthy design of valve gear for locomotives. (500 words & fig.)

1929 621 .13 (0 (.42)
Railway Engineer, January, p. 2 and 23.
Steel sleepers on the Southern Railway. (800 words; 700 words & fig.)

1929 621 .13 (0 (.42)
Railway Engineer, January, p. 2.
British locomotive practice in 1928. (1 600 words.)

1929 621 .138.5
Railway Engineer, January, p. 5.
The locomotive machine shop. (1 000 words.)

1929 625 .13 (.42) & 621 .392 (.42)
Railway Engineer, January, p. 24.
Strengthening of bridges by electric welding. (700 words & fig.)

1929 621 .132.8 (.54)
Railway Engineer, January, p. 28.
New Kitson-Meyer locomotives, Kalka-Simla Railway. (900 words & fig.)

1929 625 .113 & 625 .14
Railway Engineer, January, p. 30.
HEARN (Sir Gordon). — **Cost of curvature.** (4 600 words & 1 table.)

1929 625 .143.2 (.42)
Railway Engineer, January, p. 34.
Mechanical properties of British **rail-steels.** (500 words & 1 table.)

1929 385 .57 (.42)
Railway Engineer, January, p. 35.
HARGRAVE (T. H.). — **Commercial and administrative education for railway engineers.** (1 600 words.)

Railway Engineering & Maintenance. (Chicago.)

1928 625 .143.3 (.73) & 625 .245 (.73)
Ry. Eng. and Maintenance, No. 12, Dec., pp. 517 & 521.
Transverse fissure can now be located (Sperry detector). (600 words; 4 800 words & fig.)

1928 385 .586 (.73) & 625 .144.4 (.73)
Ry. Eng. and Maintenance, No. 12, December, p. 527.
Making the most of the expenditure for labor. **A study of the economics of labor saving devices and a plea for uniform maintenance forces.** (4 500 words & fig.)

1928 656 .212.8 (.73)
Ry. Eng. and Maintenance, No. 12, December, p. 532.
How the Pennsylvania knows and maintains clearances. (4 400 words & fig.)

1928 624 .1 (.73)
Ry. Eng. and Maintenance, No. 12, December, p. 538.
BENJAMIN (H. I.). — **Locating Southern Pacific bridge across Suisun Bay.** (1 500 words.)

Railway Gazette. (London.)

1928 621 .334 (.42)
Railway Gazette, No. 23, December 7, p. 724.
Auto-trucks in railway service. (400 words & fig.)

1928 625 .254 & 625 .259
Railway Gazette, No. 23, December 7, p. 725.
Synchronising **steam and automatic vacuum brakes.** (800 words & fig.)

1928 625 .142.3 (.42)
Railway Gazette, No. 23, December 7, p. 729.
Steel sleepers on the Southern Railway. (700 words & fig.)

1928 625 .233 (.42)
Railway Gazette, No. 23, December 7, p. 730.
The Vickers « V. 1 » **single battery train-lighting system.** (1 400 words & fig.)

1928 625 .4 (.42) & 656 .211 (.42)
Railway Gazette, No. 24, December 14, p. 759.
The new Piccadilly Circus **Station.** (3 500 words & fig.)

1928 621 .132.8 (.931)
Railway Gazette, No. 24, December 14, p. 767.
New 4-6-2 + 2-6-4 six-cylinder express **Garratt locomotive** for the New Zealand Government Railways. (800 words & fig.)

1928 621 .87 (.42)
Railway Gazette, No. 24, December 14, p. 769.
A handy **breakdown crane.** (500 words & fig.)

1928 625 .14 (01 & 625 .2 (01
Railway Gazette, No. 25, December 21, p. 788.
Raliway **rolling-stock and permanent way.** (900 words & fig.)

1928 347 .763 (.42)
Railway Gazette, No. 25, December 21, p. 792.
Railway road transport acts. (1 700 words.)

1928 621 .133.7
Railway Gazette, No. 26, December 28, p. 822.
LAVARDE (P.). — **Feed water injection in high-pressure locomotives.** (1 200 words.)

1928 388. (.431)
Railway Gazette, No. 26, December 28 p. 823.
The **Berlin** (Public conveyances) Traffic Company. (500 words.)

1928 656 .253 (.42)
Railway Gazette, No. 26, December 28, p. 824.
Station and signalling developments at Bournemouth Central, Southern Ry. (450 words & fig.)

1928 625 .232 (.942)
Railway Gazette, No. 26, December 28, p. 826.
New **dining car,** South Australian Rys. (550 words & fig.)

1928 625 .216
Railway Gazette, No. 26, December 28, p. 830.
New **automatic coupler for railway vehicles.** (200 words & fig.)

1929 625 .245 (.42)
Railway Gazette, No. 1, January 4, p. 11.
Special vehicles for conveying pulverised fuel by rail. (700 words & fig.)

1929 656 .254 (.42)
Railway Gazette, No. 1, January 4, p. 12.
Relay automatic **telephones** on the London & North Eastern Ry. (1 100 words.)

1929 621 .92 (.42)
Railway Gazette, No. 1, January 4, p. 13.
Double-headed **grinding machine** for locomotive shops (400 words & fig.)

1929 621 .132.3 (.42)
Railway Gazette, No. 1, January 4, p. 15.
New series **4-6-0 type locomotives,** Great Western Ry. (400 words & fig.)

1929 621 .132.3 (.42)
Railway Gazette, No. 1, January 4, p. 17.
New **4-6-0 locomotive,** London & North Eastern Ry. (600 words & fig.)

1929 656 .283 (.42)
Railway Gazette, No. 1, January 4, p. 26.
Railway accident report. Darlington, London & North Eastern : June 27, 1928. (1 700 words & fig.)

Railway Magazine. (London.)

1928-1929 656 .222.1 (.42)
Railway Magazine, December, p. 436, January, p. 38.
ALLEN (C. J.). — British **locomotive practice and performance.** (9 600 words, 7 tables & fig.)

1929 625 .113 (.42)
Railway Magazine, January, p. 30.
The main line **gradients** of British railways. (1 600 words, table & fig.)

Railway Mechanical Engineer. (New-York.)

1928 621 .132.3 (.43) & 621 .134.3 (.43)
Railway Mechanical Engineer, December, p. 670.
WAGNER (R. P.). — Schmidt **high pressure locomotive.** (5 200 words, 1 table & fig.)

1928 621 .132.6 (.73)
Railway Mechanical Engineer, December, p. 677.
Boston & Albany **suburban locomotives** (double-end **4-6-6 tank type**). (1 000 words, 1 table & fig.)

1928 621 .134.1 (.73)
Railway Mechanical Engineer, December, p. 681.
An analysis of the design of crosshead guides. (1 100 words, 1 table & fig.)

1928 625 .26 (.71)
Railway Mechanical Engineer, December, p. 683.
Passenger car repairs on the Grand Trunk Western. (3 000 words & fig.)

1928 313 .385
Railway Mechanical Engineer, December, p. 690.
Making statistics interesting. (1 200 words & fig.)

1928 625 .232 (.73)
Railway Mechanical Engineer, December, p. 693.
Union Pacific buys long **coaches** (83-ft. **all-steel cars**). (2 200 words & fig.)

1928 621 .138.5 (.73)
Railway Mechanical Engineer, December, p. 697.
Getting buck to fundamentels. Chicago & Alton restores **locomotive spring rigging and motion work** to original blue-print dimensions. (3 000 words & fig.)

Railway Signaling. (Chicago.)

1928 656 .253 (.73)
Railway Signaling, No. 12, December, p. 435.
Pacific Electric protects subway traffic with **signals and train stops.** (2 000 words & fig.)

1928 656 .255 (.73)
Railway Signaling, No. 12, December, p. 439.
Frisco operates trains by **signals.** (1 100 words & fig.)

1928 656 .253 (.73)
Railway Signaling, No. 12, December, p. 443.
DAYTON (W. L.). — Grand Trunk installs **light signals.** (1 500 words & fig.)

1928 656 .253 (.73)
Railway Signaling, No. 12, December, p. 445.
CHRISTOFFERSON (C. A.). — **Equipping oil lamps for electric lighting.** (600 words & fig.)

1928 385 .3 (.73) & 656 .253 (.73)
Railway Signaling, No. 12, December, p. 446.
Interstate Commerce Commission issues **report on train control.** (1 400 words.)

1928 656 .253 (.73)
Railway Signaling, No. 12, December, p. 448.
PEABODY (J. A.). — **Automatic train control** on the Chicago & North Western. (5 000 words, 1 table & fig.)

South African Railways and Harbours Magazine. (Johannesburg.)

1928 385. (09.1 (.68)
South African Rys. & Harbours Mag., Nov., p. 1802.
The George-Knysna Railway. (2 000 words & fig.)

1928 656 .1 (68) & 656 .2 (.68)
South African Rys. & Harbours Mag., Nov., p. 1835.
MORE (J. R.). — Competition between Railway and Road. (2 400 words.)

University of Illinois Bulletin. (Urbana.)

1928 62 (01 & 691
University of Illinois Bulletin, No. 185, Nov. 20, p. 8.
RICHART (F. E.), BRANDTZAEG (A.) and BROWN (R. L.). — A study of the failure of concrete under combined compressive stresses. (31 000 words, 11 tables & fig.)

In Spanish.

Gaceta de los Caminos de hierro (Madrid.)

1928 385. (09.1 (.675)
Gac. de los Caminos de hierro, nº 3569, 10 de dic., p. 409.
El desarrollo de las lineas férreas del Congo Belga. (2 000 palabras.)

Ingenieria y Construcción. (Madrid.)

1928 621 .335 (.460)
Ingenieria y construcción, diciembre, p. 617.
de URIARTE (I.). — Las locomotoras eléctricas, 7 000 y 7 100 de la Compañía del Norte. (6 000 palabras, 1 cuadro & fig.)

Revista de Obras Públicas. (Madrid.)

1928 624 .63
Revista de Obras Públicas, nº 24, 15 de diciembre, p. 429.
RIBERA (J. E.). — Ventajas de las armaduras rigidas para la construcción de los grandes arcos de hormigón armado. (750 palabras y fig.)

1928 624 .6
Revista de Obras Públicas, nº 24, 15 de diciembre, p. 432.
LOPEZ RODRIGUEZ (J.). — Algo sobre el espesor de los arcos de fábrica. (1 800 palabras y 7 cuadros.)

1929 691
Revista de Obras Públicas, nº 1, 1 de enero, p. 4.
SIERRA (Luis). — Dosificatión racional de los hormigones. (2 300 palabras, 4 cuadros y fig.)

In Italian.

Annali dei lavori pubblici. (Roma.)

1928 624 .32 (.45)
Annali dei lavori pubblici, settembre, p. 765.
BERNARDO SANTI (G. C.). — Nuove ponte sul fiume Dezzo a Corna di Darfo. (2 400 parole & fig.)

L'Ingegnere. (Roma.)

1928 621 .13 (09
L'Ingegnere, novembre, p. 634.
OTTONE (G.). — Aspetti caratteristici della evoluzione della locomotiva a vapore. (5 000 parole.)

1928 621 .132.8 & 621 .43
L'Ingegnere, novembre, p. 639.
HOCKE (E.). — Locomotive con motore Diesel. (3 300 parole & fig.)

Rivista delle comunicazioni ferroviarie. (Roma.)

1928 385 .113 (.45)
Rivista delle comunic. ferrov., nº 23, 1º dicembre, p. 11.
I risultati delle Ferrovie dello Stato nell' ultimo esercizio. (3 500 parole & 2 tavole.)

1929 625 .245 (.42) & 656 .261 (.42)
Rivista delle comunic. ferrov., nº 1, 1º gennaio, p. 13.
Per una larga adozione delle casse mobili nei trasporti misti su ferrovie e strade ferrate. (1 100 parole & fig.)

Rivista tecnica delle ferrovie italiane. (Roma.)

1928 341 .324
Rivista delle ferrov. ital., 15 novembre, p. 213.
MONTI (E.). — Il problema ferroviario militare in relazione alle operazioni di guerra (Sguardo sintetico) (16 000 parole & 2 tavole.)

In Dutch.

De Ingenieur. (Den Haag.)

1928 656 .1 (.92) & 656 .2 (.92)
De Ingenieur, nr 50, 15 December, p. V. 109.
HAARMAN (W. C. D.). — Spoorwegen en spoorwegplannen in Nederlandsch Indië. (4 200 woorden.)

1928 656 .222.5 (.43)
De Ingenieur, nr 50, 15 December, p. V. 114.
Rationaliseering der personentreindiensten bij de Duitsche spoorwegen. (900 woorden & 5 tabellen.)

1928 627 .82
De Ingenieur, nr 51, 22 December, p. B. 325.
VAN LINDEN VAN DEN HEUVELL (A.). — Waterkeerende dijken en spoorwegdijken. (1 600 woorden.)

De Locomotief. (Amsterdam.)

1928 621 .133.1

De Locomotief, nr 51, 19 December, p. 401.

Nieuwe uitvoeringen bij locomotiefconstructies tot vermeerdering der warmte-economie. (2 700 woorden & 1 tabel.)

Spoor- en Tramwegen. (Utrecht.)

1928 621 .132.3 (.492)

Spoor- en Tramwegen, nr 12, 11 December, p. 368.

LABRIJN (P.). — **Nieuwe locomotieven voor de Nederlandsche Spoorwegen.** (1 300 woorden, 1 tabel & fig.)

1928 385 .57 (.43)

Spoor- en Tramwegen, nr 12, 11 December, p. 372.

EVERS (J. D.). — **Psychotechniek en hare toepassing bij de Duitsche Spoorwegen.** (3 000 woorden.)

1928 625 .4 (.43)

Spoor- en Tramwegen, nr 12, 11 December, p. 374.

De Duitsche **Zugspitsbahn.** (600 woorden & fig.)

1928 625 .232 (.42)

Spoor- en Tramwegen, nr 13, 25 December, p. 403.

L. N. E. R. derde klas **slaapwagens.** (600 woorden & fig.)

1928 656 .211.7 (.431 + .485)

Spoor- en Tramwegen, nr 13, 25 December, p. 405.

Spoorwegveer Sassnitz-Trälleborg. (1 000 woorden & fig.)

1928 625 .173 (.492)

Spoor- en Tramwegen, nr 13, 25 December, p. 407.

VAN STUYVENBERG (J.). — Een vlugge en goedkoope wijze van **spoorwegvernieuwing.** (700 woorden & fig.)

1928 385. (09.1 (.496 + .56)

Spoor- en Tramwegen, nr 13, 25 December, p. 422.

BROEK (J. O. M.). — Het **Turksche Spoorwegnet.** (2 600 woorden & fig.)

1929 385 .517.7 (.492)

Spoor- en Tramwegen, nr 1, 8 Januari, p. 1.

JONCKERS-NIBOER (Dr. J. H.). — De **woningzorg** bij de Nederlandsche Spoorwegen. (1 500 woorden & fig.)

1929 621 .132.8

Spoor- en Tramwegen, nr 1, 8 Januari, p. 6.

ROSENTHAL (G. A.). — « Sentinel Cammel » **stoomkrachtvoertuigen.** (3 500 woorden & fig.)

In Polish.

Inzynier Kolejowy. (Warszawa.)

1928 624 .6

Inzynier Kolejowy, 1 Grudnia, str. 481.

BALICKI (Z.). — Budowa dwóch najwiekszych w swiecie **mostów sklepionych.** (2 000 slowa & rys.)

1928 621 .132.8

Inzynier Kolejowy, 1 Grudnia, str. 489.

Wagony motorowe y silnikiem parowym typu Clayton Wagons Ltd. (1 700 slowa & rys.)

In Portuguese.

Gazeta dos Caminhos de Ferro. (Lisboa.)

1928 625 .1 (.44 + .45)

Gazeta dos Caminhos de ferro, nº 983, 1 de Dez., p. 358.

A nova **linha internacional** Cuneo-Breil-Ventimiglia-Nice. (1 600 palavras & fig.)

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[016 .385 (02]

I. — BOOKS.

In French.

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ADAM (I. P.).

Manuel du tourneur mécanicien.

Paris. Albin Michel, éditeur, 22, rue Huyghens. 8e édition. In-16, orné de 43 fig. (Prix : 9 francs.)

1929 385. (02

Annuaire 1928-1929 de la Chambre syndicale des Fabricants et des Constructeurs de matériel pour chemins de fer et tramways.

Paris, 7, rue de Madrid. Un volume in-8° de 1 140 pages. (Prix : 40 francs.)

1929 656. (02

CALOT (Charles), Chef du Service des Réclamations à la Compagnie d'Orléans.

Les transports commerciaux. Chemins de fer. Navigation. Automobilisme. Aviation. Manuel pratique.

Paris (Ve), Librairie Delagrave, 15, rue Soufflot. Un volume (130 × 190). (Prix : 20 francs.)

1929 621 .31

DROUIN (F.).

Centrales électriques.

Paris, J. Baillière, éditeur. Un volume, grand in-8° de 602 pages, avec 242 figures. (Prix : 85 francs.)

1929 669

GUILLET (Léon), membre de l'Institut, directeur de l'Ecole Centrale des Arts et Manufactures, professeur au Conservatoire des Arts et Métiers.

L'évolution de la métallurgie.

Paris, Félix Alcan, éditeur. Un volume in-16 de 196 pages, avec 37 fig. (Prix : 15 francs.)

1929 385. (02

LAMALLE (U.), Directeur de l'Exploitation de la Société Nationale des Chemins de fer belges.

Cours d'exploitation des chemins de fer. Tome I : Exploitation commerciale.

Paris (6e), Dunod, éditeur, 92, rue Bonaparte; Louvain, Librairie Universitaire, 10, rue de la Monnaie. (22 × 28 cm.), 196 pages, 79 fig. (Prix : 45 francs.)

1929 621. (02

MARQUET (A.), ingénieur des Arts et Métiers.

Carnet d'atelier à l'usage des cours d'apprentissage, des écoles et cours professionnels.

Paris (6e), Dunod, éditeur, 92, rue Bonaparte. (21 × 27 cm.), 136 pages, 60 fig. (Prix : 16 francs.)

1929 624 .92

PERBAL (Louis).

Considérations inédites sur les **charpentes métalliques.**

Paris (6e), Dunod, éditeur, 92, rue Bonaparte. (21 × 27 cm.), VIII-190 pages, 206 fig. & 30 tableaux. (Prix : 45 francs.)

1929 669

RÉGNAULD (M.), ingénieur principal de l'Artillerie navale.

Méthodes et procédés métallurgiques.

Paris, Gauthier-Villars et Cie, éditeurs. Un volume in-8° de 342 pages, avec 107 figures. (Prix : 60 francs.)

1929 693

SIMONET (E.), conducteur des Ponts et Chaussées & GUILLEMOT (R.), ingénieur des Travaux publics de l'Etat.

Maçonneries.

Paris (6e), Dunod, éditeur, 92, rue Bonaparte (12 × 18 cm.), XII-460 pages, 108 fig. (Prix : 48 francs.)

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In German.

1929 385. (02 (.43)

Deutscher Reichsbahn-Kalender 1929. Herausgegeben von H. Baumann.

Leipzig, Konkordia-Verlag, 6, Goethestrasse. 1 Band, 160 Seiten mit Abb. (Preis : 4 Rm.)

1928 385 .57 (.43)

HEYDT (C.), Dr.-Ing.

Die psychotechnische Versuchsstelle der Reichsbahndirektion Berlin.

Berlin. Verkehrswissenschaftliche Lehrmittelgesellschaft m. b. H. bei der Deutschen Reichsbahn. (Preis : 0.50 Rm.)

1928 385 .1 (.42)

HOMBERGER (L.).

Wirtschaftsführung und Finanzwesen bei den englischen Eisenbahnen. 64 Seiten. 9 Anlagen.

Berlin, Verkehrswissenschaftliche Lehrmittelgesellschaft m. b. H. bei der Deutschen Reichsbahn. (Preis : 4.80 Rm.)

1928 624 (.43), 625 (.43) & 725 (.43)

Ingenieurbauten der Deutschen Reichsbahn. Bildsammlung mit etwa 170 Kupfertiefdruck-Abbildungen. Format Din A 5.

Berlin. Herausgegeben von der Deutschen Reichsbahn-Gesellschaft im Verlag der Verkehrswissenschaftlichen Lehrmittelgesellschaft bei der Deutschen Reichsbahn. (Preis, in Leinen geb. : 15 Rm.)

1928 351 .812 (.43)

KITTEL (Theodor), FRIEBE (Kurt) und HAY (Edward).

Die Eisenbahn-Verkehrsordnung vom 16. Mai 1928 nebst den amtlichen allgemeinen Ausführungsbestimmungen mit Erläuterungen und Hinweisen auf die deutsche und österreichische Rechtsprechung. Zweite, vollständig umgearbeitete Auflage.

Berlin. S. W. 61. Verlag von Reimar Hobbing. 306 Seiten Din. A 5. (Preis, in Ganzleinenband : 12 Rm.)

1928 385. (03

RÖLL.

Enzyklopädie des Eisenbahnwesens. Zweite, vollständig neubearbeitete Auflage. 10 Bände, 1911 bis 1923. 3 589 Abb. 68 Tafeln und 32 Karten. Berlin-Wien. Urban & Schwarzenberg. (Preis : 80 Rm.)

1928 625 .3

SCHMIDT-MELMS (H.).

Die Alpenbahnen. 62 S. Oktav.

Wien und Leipzig. Kommissionsverlag Sallengers Buchhandlung.

1928 656 .21

WEGELE (H.).

Bahnhofsanlagen. I. Allgemeine Anordnung; Entwicklung der Gleisanlagen. 141 S., 92 Abb. und eine Tafel. (Sammlung Göschen Bd. 989.)

Berlin und Leipzig. Walter de Gruyter & Co. (Preis geb. : 1.50 Rm.)

1928 621 .392 & 665 .882

WILD (Woldemar), Dr. rer. merc.

Die Schweisstechnik als Mittel zur Rationalisierung.

Leipzig. Uhlands Technischer Verlag G. m. b. H. (Preis brosch. : 4.50 Rm.)

In English.

1929 691

BOGUE (R. H.).

Digest of the literature on the nature of the setting and hardening processes in Portland cement. Topical digest followed by bibliography.

Washington D. C., Bureau of Standards. Paper, 6 × 9 inches, 48 pp. (Free on application.)

1929 691. (02 (.73)

BROWN (H. P.), Professor of wood technology, Syracuse, N. Y.

Atlas of the commercial woods of the United States.

Syracuse, N. Y., Extension Department, New York State College of Forestry. Paper, 6 × 9 inches, pp. 6 + 60 plates. (Price : $ 2, bound or in loose leaf form optional.)

1929 624. (02 & 69 (02

HUNTER (Adam).

Bridge and Structural Engineers' Handbook of general specifications, formulae and data for the design of cranes, bridges, foundations and workshop buildings, embodying the practice of Sir William Arrol and Company, Limited.

London, E. and F. N. Spon, Limited. Second edition. (Price : 21 sh. net.)

1929 62. (01 & 691

JOHNSON (James W.).

Concrete in tension and compression. Relationship between strength and elasticity.

Paper, 6 × 9 inches, 43 pp., diagrams and halftones. (Free on application to Director, Engineering Experiment Station, Ames, Iowa [U. S. A.].)

1929 385 .3 (.73)

LOCKLIN (D. P.).

Railroad regulation since 1920.

Chicago and New York. A. W. Shaw & Co., 211 pages. (Price : $ 2.50.)

1928 624 .2 (.42)

Report of the Bridge Stress Committee. Department of Scientific and Industrial Research.

London, H. M. Stationery Office. (13 1/2 × 8 1/4 inches). 215 pages. (Price : 18 sh. net.)

1929 691

THOMAS (H. R.) and PARKINSON (G. A.).

Concrete. Effect of physical properties of stone used as coarse aggregate on wear and compressive strength.

Austin, Tex. : University of Texas. Paper; 6 × 9 inches, 32 pp. Line cuts.

1929 38 (.73)
Traffic Bureaus and Transportation Departments of Chamber of Commerce, prepared by Transportation and Communication Department, Chamber of Commerce of the U. S. A.
Washington, D. C. Published by Chamber of Commerce of the United States. 72 pages. Apply.

1929 385 .1 (.73) & 385 .4 (.73)
Valuation of railroads. A non-technical and concise discussion of the development of a great regulatory problem.
Washington, D. C. Published by Research Office, National Association of Owners of Railroad and Public Utility Securities. 20 pages. Apply.

[016 .385. (05]

II. — PERIODICALS.

In French.

Bulletin des transports internationaux par chemins de fer. (Berne.)

1929 385 .113 (.56)
Bull. des transp. intern. par ch. de fer, janv. p. 26.
Résultats d'exploitation du chemin de fer d'Anatolie. (300 mots.)

1929 313 .385 (.438)
Bull. des transp. intern. par ch. de fer, janv., p. 31.
Résultats d'exploitation des Chemins de fer de l'Etat polonais en 1927 (Statistiques). (1 tableau.)

Chronique des transports. (Paris.)

1929 656 .231 (.44)
Chronique des Transports, n° 1, 10 janvier, p. 2.
Les réformes tarifaires réalisées par les grands réseaux en 1928. (1 900 mots.)

Génie civil. (Paris.)

1929 62. (01
Génie civil, n° 2422, 12 janvier, p. 37.
STEINSBERG (R. E.). — **Le degré d'hyperstaticité des portiques à cellules rectangulaires.** (2 800 mots & fig.)

1929 621 .392 (.73) & 624 .9 (.73)
Génie civil, n° 2422, 12 janvier, p. 45.
Charpente métallique soudée à l'arc, à Melrose Park (Illinois, E.-U.). (900 mots & fig.)

1929 621 .335 (.460) & 621 .43 (.460)
Génie civil, n° 2423, 19 janvier, p. 59.
Les automotrices à moteurs Diesel et à transmission électrique du chemin de fer de Pampelune à Saint-Sébastien. (1 500 mots & fig.)

1929 621 .116 & 669 .1
Génie civil, n° 2424. 26 janvier, p. 77.
DANTIN (Ch.). — **Le forgeage des bouilleurs de chaudières** à très haute pression. (2 400 mots & fig.)

1929 621 .134.3 (.43) & 621 .134.4 (.43)
Génie civil, n° 2424, 26 janvier, p. 87.
Locomotive compound à vapeur à 60 kg. système Schmidt. (2 000 mots & fig.)

1929 624 .92 (.44) & 665 .882 (.44)
Génie civil, n° 2425, 2 février, p. 109.
GODARD. — **Données nouvelles en matière de charpentes métalliques. Les charpentes soudées,** à l'étranger et en France. (2 700 mots & fig.)

1929 62. (01
Génie civil, n° 2425, 2 février, p. 113.
BATICLE (E.). — **Résistance des matériaux. Le flambement des arcs.** (600 mots.)

1929 62. (01
Génie civil, n° 2425, 2 février, p. 114.
Résistance des matériaux. **Arcs circulaires surbaissés ou non.** Observations de M. Mesnager au sujet de la note de M. Baticle. (2 200 mots & fig.)

1929 385. (09.1 (.44)
Génie civil, n° 2425, 2 février, p. 118.
MOUTIER (A.). — Les perfectionnements récents **dans l'exploitation des grands réseaux de chemins de fer français.** (2 300 mots.)

La Science et la Vie. (Paris.)

1929 621 .112
La Science et la Vie, février, p. 109.
LABADIE (J.). — Vers le rendement maximum **de la machine à vapeur.** (3 300 mots & fig.)

1929 625 .144
La Science et la Vie, février, p. 137.
MAUREL (J.). — Grâce à **la manutention mécanique,** des trains entretiennent et posent devant eux la voie ferrée. (1 300 mots & fig.)

Les Chemins de fer et les Tramways. (Paris.)

1929 621 .132.6
Les chemins de fer et des tramways, janvier, p. 2.
Locomotive-tender à trois essieux couplés. (1 800 mots & fig.)

1929 **621 .33 (.68)**
Les chemins de fer et les tramways, janvier, p. 4.
SPIESS (E.). — Exemple d'électrification sur voie étroite au Natal (Afrique du Sud, voie de 1 m. 067). (5 700 mots, 1 tableau & fig.)

1929 **621 .133.1 (.42) & 621 .133.7 (.42)**
Les chemins de fer et les tramways, janvier, p. 10.
L'express sans arrêt Londres-Edimbourg. Note relative à la **consommation d'eau et de charbon** et à son alimentation en eau. (1 600 mots & 1 tableau.)

1929 **656 .1**
Les chemins de fer et les tramways, janvier, p. 16.
Les **transports automobiles.** (5 900 mots & fig.)

1929 **656 .254 (.44)**
Les chemins de fer et les tramways, janvier, p. 21.
DUCHESNOY. — **L'appareil avertisseur-enregistreur de signaux** du réseau de l'Etat. (500 mots & fig.)

Revue générale des chemins de fer. (Paris.)

1929 **725 .31 (.44)**
Revue générale des chemins de fer, janvier, p. 3.
SEVIN. — Les **nouveaux bâtiments des gares** de La Baule et de Capdenac. (2 400 mots & fig.)

1929 **621 .136 (.44)**
Revue générale des chemins de fer, janvier, p. 12.
COSSART. — Nouveaux **tenders** des machines de trains rapides de la Compagnie du Nord. (2 300 mots & fig.)

1929 **656 .1 & 656 .2**
Revue générale des chemins de fer, janvier, p. 18.
Coopération entre chemin de fer et automobile. (3 800 mots.)

1929 **385 .113 (.42)**
Revue générale des chemins de fer, janvier, p. 25.
Les résultats de l'exploitation des chemins de fer britanniques en 1927. (4 000 mots & 4 tableaux.)

1929 **385. (01 (.55)**
Revue générale des chemins de fer, janvier, p. 37.
Construction d'une ligne reliant le port de Bender-Gêz sur la Mer Caspienne au Golfe Persique. (500 mots & 1 carte.)

1929 **656 .252 (.44)**
Revue générale des chemins de fer, janvier, p. 41.
Note sur l'utilisation au réseau de l'Est d'une **« perche pour lampistes ».** (700 mots & fig.)

1929 **621 .133.7**
Revue générale des chemins de fer, janvier, p. 52.
Essais de **pompes d'alimentation à vapeur pour locomotives.** (1 100 mots & fig.)

1929 **621 .131.1 (.494)**
Revue générale des chemins de fer, janvier, p. 54.
Appareil pour le sablage et le nettoyage des rails. (400 mots & fig.)

Revue universelle des transports et des communications. (Paris.)

1928 **621 .135.2 (.44)**
Revue univ. des transp. et des communic., sept., p. 86.
PAHIN (A. H.). — Les **locomotives Decapod à marchandises à 3 cylindres** à simple expansion et à surchauffe de la Compagnie des Chemins de fer de l'Est français. (3 100 mots & fig.)

1928 **625 .1 (.44 + .460)**
Revue univ. des transp. et des communic., sept., p. 91.
LAVOIEPIERRE (P.). — Le **nouveau chemin de fer** de Bedous à Jaca (ligne de Canfranc). (5 900 mots & fig.)

In German.

Archiv für Eisenbahnwesen. (Berlin.)

1928 **625 .13**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1389.
MEYER (Dr. Ing.). — Geeignete Verfahren zur **Meerengen-untertunnelung.** (19 500 Wörter.)

1928 **385 .113 (.460)**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1460.
Die Spanische Nordbahngesellschaft im Jahr 1925. (2 000 Wörter & 1 Tabelle.)

1928 **385 (.51)**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1469.
Die **Eisenbahnen Nordchinas** in den Jahren 1924-1927. (2 900 Wörter & Tabellen.)

1928 **385 .113 (.481)**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1479.
Die **Eisenbahnen in Norwegen** in den Jahren 1925-1926 und 1926-1927. (Tabellen.)

1928 **385 .113 (.436)**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1489.
Die Eisenbahnen in der Tschechoslovakischen Republik (nach dem Stand von Jahr 1925 und 1926). (4 000 Wörter & Tabellen.)

1928 **385 .113 (.92)**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1511.
OVERMANN (Dr.). — **Die Eisenbahnen in Niederländisch-Ostindien in den Jahren 1926 und 1927.** (2 200 Wörter & Tabellen.)

1928 **385 .4 (.92)**
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1517.
Der **Verwaltungsaufbau** der Staatsbahnen in Niederländisch-Ostindien. (1 000 Wörter & 1 Tafel.)

1928 621 .33 (.44)
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1520.
Die **Elektrisierungspläne** der französischen Bahnen. (500 Wörter & 1 Karte.)

1928 385 .113 (.931)
Archiv für Eisenbahnwesen, Heft 6, Nov.-Dez., S. 1521.
Die **Staatseisenbahnen in Neuseeland in den Betriebsjahren 1922-1923 bis 1926-1927.** (300 Wörter & Tabellen.)

Elektrotechnische Zeitschrift. (Berlin.)

1929 621 .335
Elektrotechnische Zeitschrift, Heft 2, 10. Januar, S. 45.
MÜLLER (W.). — Die Ermittlung der **Fahrzeit, der Motorbeanspruchung und des Stromverbrauches eines elektrischen Triebwagenzuges** aus den Motorkennlinien. (2 500 Wörter, 1 Tafel & Abb.)

1929 621 .33 (.73)
Elektrotechnische Zeitschrift, Heft 3, 17. Januar, S. 99.
Neuere **elektrische Bahnanlagen** in Amerika im Jahr 1927. (1 200 Wörter.)

1929 621 .33 (.43)
Elektrotechnische Zeitschrift, Heft 5, 31. Januar, S. 167.
Der **elektrische Betrieb der Deutschen Reichsbahn.** (900 Wörter.)

Glasers Annalen. (Berlin.)

1929 385. (09.1 (.81)
Glasers Annalen, Heft 1, 1. Januar, S. 1.
SINNER (G.). — **Vom brasilianischen Eisenbahnwesen.** (3 200 Wörter & Abb.)

1929 625 .62 (06.4 (.43)
Glasers Annalen, Heft 1, 1. Januar, S. 10.
Strassenbahn-Ausstellung in Essen vom 21. bis 31. Oktober 1928. (1 100 Wörter & Abb.)

1929 656 .212
Glasers Annalen, Heft 2, 15. Januar, S. 19.
Untersuchung neuerer **Verschiebeverfahren.** (4 200 Wörter.)

1929 621 .132.8 (.43) & 621 .133.1 (.43)
Glasers Annalen, Heft 2, 15. Januar, S. 31.
Eine neue **Kohlenstaub-Lokomotive.** (400 Wörter & Abb.)

In English.

Bulletin American Railway Engineering Association. (Chicago.)

1928 627. (06 (.73)
Bull. American Railway Eng. Ass^{on}, November, p. 259.
Report of Special Committee on **rivers and harbours.** (9 500 words & fig.)

1928 625 .142. (06 (.73)
Bull. American Railway Eng. Ass^{on}, November, p. 291.
Report of Committee III : **Ties.** (8 500 words, tables & fig.)

1928 347 .75 (06 (.73)
Bull. American Railway Eng. Ass^{on}, November, p. 323.
Report of Committee XX : **Uniform general contract forms.** (9 500 words.)

1928 621 .138 (.73) & 725 .33 (06 (.73)
Bull. American Railway Eng. Ass^{on}, November, p. 345.
Report of Committee XXIII : **Shops and locomotive terminals.** (9 500 words & fig.)

1928 385. (02 (06 (.73)
Bull. American Railway Eng. Ass^{on}, November, p. 381.
Report of Committee XII : **Rules and organisation.** (3 800 words.)

1928 656 .21 (06 (.73)
Bull. American Railway Eng. Ass^{on}, December, p. 391.
Report of Committee XIV : **Yards and terminals.** (10 000 words.)

1928 621 .3 (06 (.73)
Bull. American Railway Eng. Ass^{on}, December, p. 411.
Report of Committee XVIII: **Electricity** — and of the **Electrical section,** American Railway Association. (32 000 words, tables & fig.)

1928 625 .162. (06 (.73)
Bull. American Railway Eng. Ass^{on}, December, p. 487.
Report of Committee IX : **Grade crossings.** (5 000 words, tables & fig.)

1928 656 .25 (06 (.73)
Bull. American Railway Eng. Ass^{on}, December, p. 509.
Report of Committee X : **Signals and interlocking.** (12 000 words & tables.)

1928 625 .1 (06 (.73)
Bull. American Railway Eng. Ass^{on}, December, p. 3.
Outline of work and personnel of **Committees of the American Railway Engineering Association.** (18 000 words.)

Electric Railway Journal. (New-York.)

1928 621 .335 (.52)
Electric Railway Journal, No. 26, December 29, p. 1119.
New express passenger **electric locomotives in Japan.** (800 words, 1 table & fig.)

1929 388 (.73)
Electric Railway Journal, No. 1, January 5, p. 9.
Analysis is made of factors affecting the riding habit in large cities. (3 500 words, 2 tables & fig.)

1929 385 .11 (.73)
Electric Railway Journal, No. 2, January 12, p. 43.
Local transportation industry proves its stability. (1 500 words & fig.)

1929 385 .11 (.73)
Electric Railway Journal, No. 2, January 12, p. 46.
Upward trend shown by budget figures. (2 000 words, 3 tables & fig.)

1929 625 .1 (01 (.73)
Electric Railway Journal, No. 2, January 12, p. 63.
Track construction greater in 1928. (1 000 words, 4 tables & fig.)

1929 621 .33 (.3)
Electric Railway Journal, No. 2, January 12, p. 67.
Notable progress in heavy electric traction. (2 400 words, 3 tables & fig.)

1929 656 .1 (.73)
Electric Railway Journal, No. 2, January 12, p. 71.
Substantial growth in bus operations. (1 500 words, 3 tables & fig.)

1929 621 .338 (.73)
Electric Railway Journal, No. 2, January 12, p. 78.
Passenger car purchases in 1928 at low level. (2 200 words, 10 tables & fig.)

1929 385 .11 (.73)
Electric Railway Journal, No. 2, January 12, p. 91.
RICHEY (A. S.). — Electric railway fares and wages at highest point in 1928. (1 500 words, 2 tables & fig.)

1929 621 .33 (.73)
Electric Railway Journal, No. 3, January 19, p. 110.
Great Northern electrification extended. Opening of new Cascade tunnel. (2 000 words & fig.)

1929 625 .214 (.73)
Electric Railway Journal, No. 3, January 19, p. 114.
KAUFFMAN (H. L.). — Methods used in babbitting bearings have marked effect on lubrication. (2 800 words.)

1929 621 .338 (.73)
Electric Railway Journal, No. 3, January 19, p. 117.
BIRNEY (C. O.). — Construction details of the new Birney car. (2 600 words & fig.)

1929 725 .33 (.73)
Electric Railway Journal, No. 3, January 19, p. 121.
International Railway Co. builds one-man sand drier. (2 000 words & fig.)

Engineer. (London.)

1929 625 .1 (08 (.42)
Engineer, No. 3809, January 11, p. 55.
Railways in 1928. (2 500 words.)

1929 625 .216 & 656 .283
Engineer, No. 3810, January 18, p. 76.
Telescoping of railway carriages. (1 300 words.)

1929 621 .94 (.42
Engineer, No. 3810, January 18, p. 78.
Heavy duty railway wheel lathe. (1 400 words & fig.

1929 656 .212.8 (.42
Engineer, No. 3811, January 25, p. 90.
Automatic weighing machines. (3 200 words & fig.
(To be continued.)

1929 621 .165 (.42
Engineer, No. 3811, January 25, p. 96.
Record efficiency of a turbo-alternator. (1 300 word & fig.)

1929 621 .335 (.494
Engineer, No. 3811, January 25, p. 97.
4 000 H. P. locomotives on the Loetschberg Tunne Railway. (5 200 words & fig.)

1929 621 .11
Engineer, No. 3811, January 25, p. 106.
WEIR (J. G.). — Modern feed-water circuits. (4 80 words & fig.)

1929 621 .94 (.42
Engineer, No. 3811, January 25, p. 109.
Grinding machine for locomotive parts. (500 word & fig.)

1929 66
Engineer, No. 3811, January 25, Supplement: Th Metallurgist, p. 3.
Corrosion-fatigue of metals. (3 300 words & fig.)

1929 669 .
Engineer, No. 3811, January 25, Supplement: Th Metallurgist, p. 11.
A carburising test for steel. (1 500 words.)

1929 62. (0
Engineer, No. 3811, January 25, Supplement: Th Metallurgist, p. 12.
Elastic limit and yield stress. (1 300 words.)

1929 624 .3 (.62
Engineer, No. 3812, February 1, p. 124.
The Khartoum-Omdurman bridge. (4 500 words & fig.

1929 625 .17 (.52
Engineer, No. 3812, February 1, p. 135.
Some aspects of permanent way maintenance in Japan. (1 700 words.)

Engineering. (London.)

1929 624 .62 (.42
Engineering, No. 3287, January 11, p. 34.
The reconstruction of Holt Fleet Bridge, Worcestershire. (1 600 words & fig.)

1929 62. (01 (.42) & 669 .1 (.42
Engineering, No. 3287, January 11, p. 36.
BRADLEY (J.). — A high-speed endurance testin machine for leaf springs. (1 000 words, 1 table & fig.

1929 621 .132.8 (.42)
gineering, No. 3287, January 11, p. 45.
Crude-oil engine locomotive. (1 600 words & fig.)

1929 536
gineering, No. 3287, January 11, p. 59.
NÄGEL (A.). — The transfer of heat in reciprocating gines. (4 600 words & fig.)

1929 621 .9 (.73)
gineering, No. 3287, January 11, p. 61.
Pneumatic hand grinding and polishing machines. 000 words & fig.)

1929 62. (01 & 691
gineering, No. 3288, January 18, p. 63.
TURNER (L.). — Combined bending and direct esses in reinforced-concrete members. (3 000 words fig.)

1929 621 .116 (.42)
gineering, No. 3288, January 18, p. 73.
The Ruths steam-accumulator installation at the ver Don Steel Works, Sheffield. (3 600 words & fig.)

1929 656
gineering, No. 3288, January 18, p. 79.
Empire transport. (1 200 words.)

1929 621 .392 (.54)
gineering, No. 3288, January 18, p. 92.
Arc welder for East Indian Railway. (600 words & .)

1929 621 .335 (.54)
gineering, No. 3289, January 25, p. 100.
Electric passenger locomotive for the Great Indian ninsula Railway. (2 000 words & fig.)

1929 621 .132.8 (.42)
gineering, No. 3289, January 25, p. 117.
The geared steam locomotive. (2 400 words, 1 table fig.)

1929 621 .116
gineering, No. 3289, January 25, p. 119.
WEIR (J. G.). — Modern feed-water circuits. (4 200 ords & fig.)

1929 624 .2 (.42)
gineering, No. 3290, February 1, p. 143.
Impact on railway bridges. (3 900 words & fig.)

Engineering News-Record. (New-York.)

1929 624 .7 (.73)
gineering News-Record, No. 2, January 10, p. 54.
5-mile James River bridge built in 13 months. (3 900 ords & fig.)

1929 625 .258 (.73) & 656 .259 (.73)
Engineering News-Record, No. 2, January 10, p. 63.
Single-hump freight yard, Texas & Pacific Ry. (2 700 words & fig.)

1929 693 (.73)
Engineering News-Record, No. 3, January 17, p. 94.
Guniting steel true to cross-section and alignment. (2 100 words & fig.)

1929 624 .32 (.73)
Engineering News-Record, No. 3, January 17, p. 100.
SVERDRUP (L. J.). — Continuous truss highway bridge over Missouri River. Two 450-ft. spans crossed by 900-ft. truss at St. Joseph, Mo. — Silicon steel and riveted construction. (1 500 words & fig.)

1929 691
Engineering News-Record, No. 4, January 24, p. 129.
JOHNSON (N. C.). — Concrete. A discussion of the vital problems of the concrete industry, outlining certain obstacles to consistent quality production and indicating a line of progress. Chapter I : Difficulty of standardization. (2 500 words.) *(To be continued.)*

1929 625 .144.4 (.73)
Engineering News-Record, No. 4, January 24, p. 131.
Ballast-cleaning machine on the Pennsylvania Railroad. (800 words & fig.)

Journal of the Institute of Transport. (London.)

1929 621 .133.1
Journal of the Institute of Transport, January, p. 120.
ORMANDY (W. R.) & MÉTRAL (A.). — Fuels-alternative or supplementary to petrol — for use in internal combustion engines for road vehicles. (19 000 words & tables.)

1929 656 .223
Journal of the Institute of Transport, January, p. 175.
DAWSON (W. B.). — An outline of operating and rolling stock control. (3 200 words.)

1929 385 .113 (.82) & 621 .33 (.82)
Journal of the Institute of Transport, January, p. 183.
ECKHARD (K. N.). — Operating results of the Buenos Aires suburban electrification of the Central Argentine Railway. (3 200 words & 2 tables.)

Locomotive Railway Carriage & Wagon Review. (London.)

1929 621 .132.8 (.931)
Loc. Ry. Carriage & Wagon Review, January, p. 6.
Six-cylinder « Beyer-Garratt » locomotive, New Zealand Government Rys. (1 800 words & fig.)

1929 621 .132.1 (.593)
Loc. Ry. Carriage & Wagon Review, January, p. 10.
Recent locomotives for the Royal State Rys. of Siam. (1 300 words & fig.)

1929 621 .132.3 (.436)
Loc. Ry. Carriage & Wagon Review, January, p. 14.
New type of **express passenger locomotive**, Austrian Federal Railways. (1 200 words & fig.)

1929 621 .9 (.42)
Loc. Ry. Carriage & Wagon Review, January, p. 19.
Spring making machinery. (2 500 words & fig.)

Modern Transport. (London.)

1929 625 .245 (.42)
Modern Transport, No. 512, January 5, p. 7.
An improved **side-tipping wagon.** The Leeds Forge **dump car.** (500 words & fig.)

1929 625 .216 (.42) & 656 .283 (.42)
Modern Transport, No. 512, January 5, p. 8.
The Darlington disaster. **Dangers of telescoping in modern rolling stock.** Sir John Pringle's **recommendations.** (2 000 words & fig.)

1929 625 .216 & 656 .283
Modern Transport, No. 512, January 5, p. 9.
Preventing loss of life in railway collisions. An ingenious **anti-telescopic device.** (1 600 words & fig.)

1929 385 .113 (.43)
Modern Transport, No. 512, January 5, p. 10.
German Railway progress (1927-1928). No. 1. **Financial** and **Administrative.** (2 800 words & fig.)

1929 656 .234 (.73)
Modern Transport, No. 512, January 5, p. 12.
Modern Transport in the United States. — No. 15. — **Railway luggage arrangements.** (2 000 words & fig.)

1929 621 .132.1 (.42)
Modern Transport. No. 512, January 5, p. 17.
Transport in 1928. — **Representative British-built locomotives** for Overseas. (Fig.)

1929 656 .224 (.4 + .5)
Modern Transport, No. 513, January 12, p. 3.
BRANT (F. A.). — **International railway traffic. Organisation for Continental train working.** (2 300 words & fig.)

1929 621 .132.8 (.42)
Modern Transport. No. 513, January 12, p. 6.
BALLAN (L.). — **Light power units.** Experiences in railway traffic working (L. N. E. R.). (2 800 words.)

1929 621 .132.8 (.42)
Modern Transport, No. 513, January 12, p. 9.
WILLIANS (K. W.). — **Geared steam locomotives.** An important development. (2 100 words & fig.)

1929 656 .222.3 (.43) & 656 .234 (.43)
Modern Transport, No. 513, January 12, p. 11.
German Railway progress. — No. 2. — **Reform of passenger classification.** (1 400 words & 3 tables.)

1929 388 (.431
Modern Transport, No. 513, January 12, p. 6.
German Railway progress. — No. 3. — **Transpor** services in Berlin. (1 500 words, 1 table & 1 map.)

1929 385. (08 (.68
Modern Transport, No. 514, January 19, p. 9.
Developments on the South African Railways. Finan cial results. — Reorganisation. — Electrification. — Road transport. (2 600 words.)

1929 725 .31 (.942
Modern Transport, No. 514, January 19, p. 11.
Notable South Australian Railway development. Ne **passenger station** at Adelaide. (1 300 words & fig.)

1929 621 .33 (.73) & 625 .13 (.73
Modern Transport, No. 514, January 19, p. 12.
Railway electrification in the United States. Openin of new Cascade tunnel. (2 300 words & fig.)

1929 656 (.66 + .67
Modern Transport, No. 515, January 26, p. 3.
Transport in East Africa. — Recommendations of th Hilton Young Commission. (3 000 words.)

1929 625 .4 (.52
Modern Transport, No. 515, January 26, p. 4.
Japan's first **underground railway.** Nucleus of exte sive system. (1 700 words & fig.)

1929 656 .1 (.43) & 656 .3 (.4
Modern Transport, No. 515, January 26, p. 4.
German Railway progress. — No. 4. — **Competitio of motor transport.** (1 200 words & 2 tables.)

1929 625 .216 (.4
Modern Transport, No. 516, February 2, p. 5.
A new **automatic coupler.** Change-over simplified 1 using existing drawgear. (1 900 words & fig.)

1929 621 .335 (.7
Modern Transport, No. 516, February 2, p. 8.
Electric locomotives on American railways. Develo ments during 1928. (800 words & fig.)

1929 656 .255 (.4
Modern Transport, No. 516, February 2, p. 9.
Signalling developments in Ireland. **Conversion double into single track.** (1 800 words, 1 table & fig

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1929 625 .4 (.42 + .4
Modern Transport, No. 516, February 2, p. 11.
The **Channel tunnel.** An antagonistic view. — Fren Government's position. (1 900 words.)

Proceedings, American Society of Civil Engineer (New-York.)

1929
Proceed. Amer. Soc. Civ. Eng., January, p. 4.
RICHMOND (H. S.). — **Elastic equilibrium in t theory of structures.** (6 000 words, 1 table & fig.)

1929 624 .2 & 691
Proceed. Amer. Soc. Civ. Eng., January, p. 19.
MYLBEA (T. D.) — Studies of shear in reinforced concrete beams. (9 300 words & fig.)

Railway Age. (New-York.)

1928 656 .211.4 (.73) & 725 .31 (.73)
Railway Age, No. 26, December 29, p. 1287.
Cleveland Union station project far advanced. (4 000 words & fig.)

1928 621 .132.5 (.73)
Railway Age, No. 26, December 29. p. 1295.
Worlds largest locomotive built for the Northern Pacific. (2 600 words & fig.)

1928 656 .253 (.73)
Railway Age, No. 26, December 29, p. 1303.
Burlington installs centralized control for ends of double track. (1 700 words & fig.)

1928 625 .244 (.73)
Railway Age, No. 26, December 29, p. 1305.
Icing three cars per minute. (2 200 words & fig.)

1928 625 .139 (.73), 625 .18 (.73) & 625 .27 (.73)
Railway Age, No. 26, December 29, p. 1314.
BROWNE (O. L.). — Problems in accounting for railway supplies. (2 300 words & fig.)

1929 385. (0 (.73)
Railway Age, No. 1, January 5, p. 6.
Tendencies in the railway field. (12 000 words & fig.)

1929 656 .2 (0 (.73)
Railway Age, No. 1, January 5, p. 16.
JOHNSON (Alba B.). — Railway supply prospects in 1929. (4 000 words & fig.)

1929 385 .11 (.73)
Railway Age. No. 1, January 5, p. 22.
PARMELEE (Julius H.). — A review of railway operations in 1928. (10 000 words, 19 tables & fig.)

1929 621 .13 (.73) & 625 .2 (.73)
Railway Age, No. 1, January 5, p. 33.
PECK (C. B.). — Trends in the equipment field during 1928. (3 000 words & fig.)

1929 625 .17 (.73)
Railway Age. No. 1, January 5, p. 37.
LACHER (Walter S.). — Maintenance of way practices show improvement. (2 900 words & fig.)

1929 621 .33 (.73)
Railway Age, No. 1, January 5, p. 41.
OEHLER (Alfred G.). — Electric traction takes a big step. (1 300 words, 1 map & fig.)

1929 656 .22 (.73)
Railway Age. No. 1, January 5, p. 43.
LAYNG (Charles). — Service improvements show record progress during year. (3 200 words & fig.)

1929 385 .11 (.71)
Railway Age, No. 1, January 5, p. 47.
LYNE (James G.). — Canadian lines have their best year. (2 100 words & fig.)

1929 385 .11 (.73)
Railway Age, No. 1, January 5, p. 50.
PADILLA (L. E.). — Improved efficiency in Mexico. (2 000 words, 2 tables & fig.)

1929 385 .11 (.73)
Railway Age, No. 1, January 5, p. 54.
PATTERSON (F. M.). — A year of activity in construction. (9 500 words & fig.)

1929 385 .1 (.73)
Railway Age, No. 1, January 5, p. 63.
LYNE (J. G.). — Railway finances in 1928. (2 800 words. 8 tables & fig.)

1929 621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)
Railway Age, No. 1, January 5, p. 68.
STEEL (D. A.). — Railway material and supply costs steady in 1928. (4 700 words, 3 tables & fig.)

1929 621 .13 (.71 + .73)
Railway Age, No. 1, January 5, p. 75.
TAFT (W. J.). — Locomotive orders in 1928. (1 200 words, 4 tables & fig.)

1929 625 .24 (.71 + .73)
Railway Age, No. 1, January 5, p. 80.
KRAEGER (F. W.). — Freight car orders in 1928. (1 000 words, 4 tables & fig.)

1929 625 .23 (.71 + .73)
Railway Age, No. 1, February 5, p. 87.
LEATH (M. L.). — Passenger car orders in 1928. (600 words, 4 tables & fig.)

1929 621 .9 (.73)
Railway Age, No. 1, February 5, p. 91.
GURLEY (L. R.). — Machine tools ordered during 1928. (1 200 words, 1 table & fig.)

1929 656 .25 (.73)
Railway Age, No. 1, January 5, p. 95.
DUNN (J. H.). — Signaling construction continues in average volume during 1928. (2 800 words, 10 tables & fig.)

1929 656 .254 (.73)
Railway Age, No. 1, January 5, p. 102.
KENRICK (R. S.). — Technical advances feature 1928 communications activities. (2 300 words, 4 tables & fig.)

1929 656 .1 (.73)
Railway Age, No. 1, January 5, p. 105.
EMERY (J. C.). — **Motor coaches and trucks** more widely adopted. (2 400 words, 1 table & fig.)

1929 621 .132.8 (.71 + .73)
Railway Age, No. 1, January 5, p. 109.
PECK (C. B.). — **Rail motor car orders** in 1928. (700 words, 4 tables & fig.)

1929 621 .13 (.73) & 625 .2 (.73)
Railway Age, No. 1, January 5, p. 112.
LYNE (J. G.). — **Railway equipment prices.** (1 200 words, 3 tables & fig.)

1929 385. (0 (.42)
Railway Age, No. 1, January 5, p. 116.
FRASER (W. H.). — Traffic losses bring **innovations in British railway operation.** (3 800 words, 2 tables & fig.)

1929 385. (0 (.45)
Railway Age, No. 1, January 5, p. 120.
SPENCER (D. F.). — **Italian roads encounter expensive operation and light traffic.** (2 100 words & fig.)

1929 385. (0 (.43)
Railway Age, No. 1, January 5, p. 123.
GENEST. — **German lines reparation payments** reached maximum in 1928. (3 200 words & fig.)

1929 385. (0 (.44)
Railway Age, No. 1, January 5, p. 127.
PESCHAUD (M.). — **French railways balance budget.** (4 000 words & fig.)

1929 725 .35 (.73)
Railway Age, No. 2, January 12, p. 137.
Pennsylvania builds modern **produce terminal** at Philadelphia. (6 300 words & fig.)

1929 656 .254 (.73) & 656 .255 (.73)
Railway Age, No. 2, January 12, p. 144.
Remote control facilities save time on Southern Pacific. (2 400 words, 2 tables & fig.)

1929 621 .335 (.73) & 621 .4 (.73)
Railway Age, No. 2, January 12, p. 149.
Union Pacific **gas-electric cars.** (1 000 words & fig.)

1929 621 .118 (.73) & 313 : 656 .284 (.73)
Railway Age, No. 2, January 12, p. 153.
Annual **report of the Bureau of locomotive inspection.** (1 100 words, 2 tables & fig.)

1929 621 .33 (.73)
Railway Age, No. 3, January 19, p. 193.
JOHNSON (F. L.). — How an operating man views the Virginian **electrification.** (2 700 words & fig.)

1929 621 .132.8 (.73)
Railway Age, No. 3, January 19, p. 197.
De luxe motor train exhibited. (1 000 words & fig.)

1929 621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)
Railway Age, No. 3, January 19, p. 199.
SIMMONS (A. C.). — Chicago Great Western follows first principles in **buying.** (1 400 words & fig.)

1929 625 .253
Railway Age, No. 3, January 19, p. 202.
TERWILLIGER (G. E.). — **Stopping trains by use of the conductor's valve.** (2 000 words & fig.)

1929 614 .8 (.73)
Railway Age, No. 3, January 19, p. 207.
Safety section recommends **contests.** (900 words.)

1929 621 .138.2 (.73)
Railway Age, No. 3, January 19, p. 210.
Protecting coal while in storage. (800 words & fig.)

Railway Engineer. (London.)

1929 621 .132.5 (.54)
Railway Engineer, February, p. 53.
New 5-ft. 6-in. gauge 2-8-2 type **heavy freight engines and tenders** for the Indian State railways. (2 200 words & fig.)

1929 621 .138.2 (.42)
Railway Engineer, February, p. 58.
Boiler shop developments at Swindon Works, Great Western Railway. (3 700 words & fig.)

1929 621 .132.8
Railway Engineer, February, p. 65.
The **geared steam locomotive.** (550 words.)

1929 621 .135. (01 & 625 .14 (01
Railway Engineer, February, p. 66.
Railway **rolling-stock and permanent way.** (1 800 words & fig.)

1929 656 .253 (.42)
Railway Engineer, February, p. 68.
Proving the **distant signal.** (500 words & fig.)

1929 625 .232 (.42)
Railway Engineer, February, p. 69.
New all-steel **Pullman cars** for service on the L. N. E. R. (1 400 words & fig.)

1929 621 .134.3
Railway Engineer, February, p. 75.
DARLING (C. S.). — **High-pressure steam for locomotives.** (1 400 words, 7 tables & fig.)

Railway Engineering & Maintenance. (Chicago.)

1929 625 .144.4 (.73)
Railway Engineering and Maintenance, January, p. 4.
Ballast cleaner on the Pennsylvania completes a mile a day. (3 000 words & fig.)

1929 625 .144.4 (.73)
Railway Engineering and Maintenance, January, p. 12.
Overhead air supply frame aids use of power tools. (1 500 words & fig.)

1929 625 .27 (.73)
Railway Engineering and Maintenance, January, p. 14.
Consolidated roadway stores insure prompt deliveries. (2 400 words & fig.)

1929 625 .175 (.73)
Railway Engineering and Maintenance, January, p. 18.
The use and care of (truck) motor cars on the Union Pacific. (1 800 words & fig.)

1929 625 .144.4
Railway Engineering and Maintenance, January, p. 20.
Is winter rail laying practical? (2 000 words & fig.)

1929 625 .175 (.73)
Railway Engineering and Maintenance, January, p. 23.
Something new in (track motor) cars for fast inspection work. (1 000 words & fig.)

Railway Gazette. (London.)

1929 656 .211 (.68)
Railway Gazette, No. 2, January 11, p. 41.
New station at Johannesburg. (700 words & fig.)

1929 625 .232 (.62)
Railway Gazette, No. 2, January 11, p. 45.
New Pullman and sleeping cars for Egypt. (850 words & fig.)

1929 656 .255
Railway Gazette, No. 3, January 18, p. 77.
LEAKE (F. W.). — Token instruments and their use in securing safety in single-line working. (1 600 words.)

1929 656 .1 (.6)
Railway Gazette, No. 3, January 18, p. 81.
Motor transport in British dependencies. (900 words.)

1929 656 .1 (.44)
Railway Gazette, No. 3, January 18, p. 82.
The rail and road situation in France. (600 words.)

1929 625 .232 (.44) & 656 .222.5 (.44)
Railway Gazette. No. 4, January 25, p. 112.
The New « Blue Train » Calais-Mediterranean express. (1 300 words & fig.)

1929 621 .132.7 (.42)
Railway Gazette, No. 4, January 25, p. 115.
New 0-6-0 type tank locomotives, London Midland & Scottish Railway. (300 words & fig.)

1929 625 .231 (.44)
Railway Gazette, No. 4, January 25. p. 117.
New brake vans for the International Sleeping Car Company. (550 words, 1 table & fig.)

1929 621 .132.8 (.82) & 625 .175 (.82)
Railway Gazette, No. 4, January 25, p. 119.
An internal-combustion inspection coach. (1 100 words & fig.)

1929 624 .2 (.42)
Railway Gazette, No. 5, February 1, p. 145.
The report of the Bridge Stress Committee. (1 100 words.)

1929 385 .586 (.42)
Railway Gazette, No. 5, February 1, p. 146.
Technical education for permanent way staff. (700 words.)

1929 625 .17 (.52)
Railway Gazette, No. 5, February 1, p. 147.
Permanent way maintenance in Japan. (1 500 words.)

1929 621 .132.8 (.56)
Railway Gazette, No. 5, February 1, p. 148.
New « Sentinel-Cammell » articulated steam rail cars for the Palestine Railways. (800 words & fig.)

1929 625 .616 (.54)
Railway Gazette, No. 5, February 1, p. 151.
New narrow-gauge locomotives for India. (1 100 words & fig.)

Railway Magazine. (London.)

1929 656 .222.1 (.42)
Railway Magazine, February, p. 117.
ALLEN (C. J.). — British locomotive practice and performance. (2 800 words, 3 tables & fig.)

Railway Mechanical Engineer. (New-York.)

1928 621 .134.2 (.73)
Railway Mechanical Engineer, November, p. 615.
Caprotti gear applied to the « President Cleveland », Baltimore & Ohio conducting tests with 4-6-2 type locomotive exhibited at Atlantic City. (2 800 words, 1 table & fig.)

1928 621 .131.3 (.73)
Railway Mechanical Engineer, November, p. 620.
Plant tests on the auxiliary locomotive. Report on a series of tests run at Altoona. Develops drawbar pull of 12 022 lb. at 7.3 m. p. h. (2 900 words, 3 tables & fig.)

1928 621 .133.2 & 621 .133.4
Railway Mechanical Engineer. November, p. 625.
ROESCH (F. P.). — Front ends, grates and ash pans. (3 600 words & fig.)

1928 625 .2 (06 (.73)
Railway Mechanical Engineer. November, p. 629.
Additional proceedings at Car Supervisors' convention (September 1928). — Efficiency of car shop operation, question box report and interchange rules discussed. (10 000 words.)

1928 625 .244 (.73)
Railway Mechanical Engineer, November, p. 640.
Refrigerator cars for the Fruit Growers Express. (1 800 words & fig.)

1928 621 .9
Railway Mechanical Engineer, November, p. 643.
NORTH (L. A.). — **Machine tools.** — Their use and application. (2 300 words & fig.)

1928 621 .9 (.73)
Railway Mechanical Engineer, November, p. 651.
Small tools developed at Maine Central shops. — Special reamers, end mills and jigs designed to expedite locomotive repairs. (2 000 words & fig.)

1929 621 .132.8 (.73)
Railway Mechanical Engineer, January, p. 4.
Simple articulated locomotive for the Southern Pacific. (2 200 words, 2 tables & fig.)

1929 621 .118 (.73) & 313 : 656 .284 (.73)
Railway Mechanical Engineer, January, p. 8.
Bureau of Locomotive Inspection annual report. (1 100 words, 1 table & fig.)

1929 625 .245 (.71)
Railway Mechanical Engineer, January, p. 11.
New **dynamometer car** for the Canadian Pacific. (2 900 words & fig.)

1929 625 .253 (.73)
Railway Mechanical Engineer, January, p. 16.
STEWART (J. P.). — **Angle cock elimination.** (1 800 words.)

1929 625 .232 (.73)
Railway Mechanical Engineer, January, p. 18.
Passenger cars for the Chicago & North Western. (900 words & fig.)

1929 625 .26 (.73)
Railway Mechanical Engineer, January, p. 21.
Pennsylvania Westbound **freight car repair yard.** (2 000 words, 2 tables & fig.)

1929 621 .9 (.73)
Railway Mechanical Engineer, January, p. 27.
New machines prove profitable in Milwaukee cabinet shop. (1 600 words, 2 tables & fig.)

1929 621 .138 (.73)
Railway Mechanical Engineer, January, p. 31.
Bangor & Arostook **inspection cards.** (550 words & fig.)

1929 621 .138.5 (.73) & 725 .33 (.73)
Railway Mechanical Engineer, January, p. 32.
The Norfolk & Western **machine shop** at Roanoke. (2 500 words, 4 tables & fig.)

Railway Signaling. (Chicago.)

1928 656 .253 (.73) & 656 .256.2 (.73)
Railway Signaling, No. 11, November, p. 399.
CULLEN (R. J.). — Boston and Albany installs a **248-lever electric interlocking.** (2 500 words & fig.)

1928 656 .256 (.73)
Railway Signaling, No. 11, November, p. 403.
McCULLOUGH (R. Y.). — The use of **capacitors on railway transmission lines.** (1 200 words, 1 table & fig.)

1928 656 .255 (.73) & 656 .256.3 (.73)
Railway Signaling, No. 11, November, p. 405.
Oregon short line installs 39 miles of **color-light automatics.** (1 600 words & fig.)

1928 625 .162 (.73) & 656 .259 (.73)
Railway Signaling, No. 11, November, p. 408.
RUDD (E. Irvine). — **Accidents and protective devices at grade crossings.** (3 200 words, 1 table & fig.)

1928 656 .257 (.73)
Railway Signaling, No. 11, November, p. 411.
Pressure grease fittings save time at interlockers on Union Pacific. (1 000 words & fig.)

1928 385 .3 (.73) & 656 .253 (.73)
Railway Signaling, No. 11, November, p. 413.
Interstate Commerce Commission reports on inspection of **train stop** on Pennsylvania. (3 400 words & fig.)

1928 313 : 625 .25 (.73)
Railway Signaling, No. 11, November, p. 417.
Interstate Commerce Commission issues annual **statistics. Automatic block signal mileage** increased 4 150 miles during 1927. (1 000 words & tables.)

1929 656 .25-(08 (.73)
Railway Signaling, No. 1, January, p. 1.
Signaling and interlocking construction continues in 10-year average volume during 1928. (2 600 words, 10 tables & fig.)

1929 656 .253 (.73)
Railway Signaling, No. 1, January, p. 16.
Frisco installs **semaphores with color light indication.** A 5-watt, 10 volt bulb, with reflector gives a daylight indication up to 5 000 feet. (800 words & fig.)

1929 656 .254 (.73) & 656 .255 (.73)
Railway Signaling, No. 1, January, p. 17.
Centralized control used for ends of double track (Chicago, Burlington & Quincy). (1 900 words & fig.)

1929 656 .253 (.73)
Railway Signaling, No. 1, January, p. 19.
RICE (P. X.). — A magneto « tune tester » for **train control.** (900 words & fig.)

1929 656 .253 (.73)
Railway Signaling, No. 1, January, p. 21.
Chicago & Alton modernizes signaling facilities (automatic train control installed in connection with construction program). (2 100 words & fig.)

1929 656 .253 (.73)
Railway Signaling. No. 1, January, p. 23.
JONES (I. S.). — Northern Pacific carries out many absolute permissive block circuit refinements. (1 300 words & fig.)

1929 625 .162 (.73) & 656 .254 (.73)
Railway Signaling, No. 1, January, p. 25.
Flashing-light crossing signals save money for Wabash. (2 000 words & fig.)

In Spanish.

Gaceta de los Caminos de hierro. (Madrid.)

1929 625 .244
Gaceta de los Cam. de hierro, nº 3572, 10 de enero, p. 13.
El aislamiento como factor esencial a todos los tipos de vagones frigoríficos. (1 100 palabras.)

Ingenieria y Construcción. (Madrid)

1929 691
Ingenieria y construcción, enero, p. 26.
MARCHESI (J. M.). — Algunas consideraciones sobre resistencia de hormigones. (1 200 palabras & fig.)

1929 621 .131.1 & 621 .133.1
Ingenieria y construcción, enero, p. 29.
BURGALETA (S.). — Cálculo del poder calorífico de un combustible para la determinación del rendimiento de una locomotora de vapor. (5 000 palabras.)

Revista de Obras Públicas. (Madrid.)

1929 624 .32 (.64)
Revista de Obras Públicas. No. 3, 1º de febrero, p. 49.
Puente de Alfonso XIII, sobre el Luccus, en Larache. (4 000 palabras & fig.)

In Italian.

Annali dei lavori pubblici. (Roma.)

1928 621 .31 (.45)
Annali dei lavori pubblici, ottobre, p. 857.
Gli impianti di produzione, trasporto e distribuzione di energia elettrica in Italia, all'inizio del 1928. Notizie d'assieme e dati statistici. (6 700 parole. 5 tavole & fig.)

1928 624. (06 (.436)
Annali dei lavori pubblici, ottobre, p. 941.
Il secondo Congresso internazionale dei ponti. (Vienna, settembre-ottobre 1928). (8 000 parole & 1 tavola.)

L'Ingegnere. (Roma.)

1928 625 .5 (.45)
L'Ingegnere, dicembre, p. 695.
BAREGGI (M.). — La funicolare centrale al Vomero. (3 700 parole, 1 tavola & fig.)

1928 624 .63 (01
L'Ingegnere, dicembre, p. 704.
STABILINI (L.). — Il calcolo dei ponti ad arco di cemento armato. (2 700 parole & fig.)

Rivista delle comunicazioni ferroviarie. (Roma.)

1929 656 .211.5 (.45)
Riv. delle comunic. ferrov., nº 2, 15 gennaio, p. 9.
TEDESCHINI-LALLI (E.). — L'abbellimento delle stazioni e degli altri impianti ferroviari. Il concorso 1928. (1 400 parole & fig.)

Rivista tecnica delle ferrovie italiane. (Roma.)

1928 621 .31 (.45) & 627 .82 (.45)
Rivista tecnica delle ferrovie italiane, 15 nov., p. 197.
PELAGATTI (F.). — Impianti idroelettrici dell-alto Reno e delle Limentre. Impianto di Pavana. (5 000 parole & fig.)

1928 627 (.4) & 656 .2 (.4)
Rivista tecnica delle ferrovie italiane. 15 dic., p. 288.
MALTESE (Salvatore). — I grandi porti Europei dal punto di vista del traffico ferroviario. (4 000 parole & fig.)

1928 625 .113 (.45)
Rivista tecnica delle ferrovie italiane, 15 dic., p. 295.
GIOVENE (N.). — L'armamento in curva. Le nuove istruzioni delle Ferrovie dello Stato. (2 500 parole.)

In Dutch.

De Ingenieur. (Den Haag.)

1929 385. (09.1 (.92)
De Ingenieur, nr 2, 12 Januari, p. V. 1.
WEGENER SLEESWYK (F. O.). — Uitbreiding van de spoorwegen in en om Batavia en Tandjong Priok. (6 500 woorden & fig.)

1929 621 .31 (.73)
De Ingenieur, nr 4, 26 Januari, p. E. 9.
VAN THUYN (H. E.). — De elektrische uitrusting eener groote Amerikaansche centrale. (7 000 woorden & fig.)

1929 625 .62 & 656 .1
De Ingenieur, nr 5, 2 Februari, p. V. 13.
NIEUWENHUIS (J. G. J. C.). — Tram of autobus? (5 900 woorden, 4 tabelen & fig.)

1929 **656 .212.6 (.492)**
De Ingenieur, nr 5, 2 Februari, p. V. 23.
MUNDT (Th. W.). — De **overlaadrichting voor groenten** te Bovenkarspel-Grootebroek. (2 000 woorden & fig.)

De Locomotief. (Amsterdam.)

1929 **656 .256.3 (.431)**
De Locomotief, nr 2, 9 Januari, p. 9.
De zelfwerkende « Bergmann Steuerung » by de Berlijnsche Spoorwegen. (2 400 woorden & fig.)

1929 **621 .132.8**
De Locomotief, nr 3, 16 Januari, p. 18.
Vervoer van reizigers op tramwegen met **benzine-motor-rijtuigen.** (1 400 woorden & fig.)

1929 **625 .62 (.43)**
De Locomotief, nr 5, 30 Januari, p. 38.
Waschmachine voor het reinigen van tramrijtuigen. (450 woorden & fig.)

Spoor- en Tramwegen. (Utrecht.)

1929 **656 .224 (.492)**
Spoor- en Tramwegen, nr 2, 22 Januari, p. 36.
POSTHUMUS MEYJES (P. Th.). — Iets over het **reizigersvervoer** op drukke zomerzondagen tusschen Amsterdam C. S. Haarlem P. en Zandvoort Bad. (4 000 woorden & fig.)

1929 **621 .132.6 (.43)**
Spoor- en Tramwegen, nr 2, 22 Januari, p. 41.
Twee interessante nieuwe **tenderlocomotieven** in Duitschland. (700 woorden & fig.)

1929 **385 .517.7 (.492)**
Spoor- en Tramwegen, nr 2, 22 Januari, p. 43.
JONCKERS NIEBOER (J. H.). — De **woningzorg** bij de Nederlandsche spoorwegen. (1 200 woorden & fig.) (Vervolg en slot.)

1929 **385. (01 (.91)**
Spoor- en Tramwegen, nr 2, 22 Januari, p. 52.
WORTH (W. J.). — **Spoorweg pionierwerk** in Borneo. De Noord-Borneo spoorweg. (2 300 woorden & fig.)

1929 **656 .222 (.492)**
Spoor- en Tramwegen, nr 3, 5 Februari, p. 74.
KLEIJN (F. J.). — Eenige mededeelingen over het **vaststellen der Rijtijden** van de door stoomlocomotieven getrokken reizigerstreinen der Nederlandsche Spoorwegen (wordt vervolgt). (1 800 woorden & tafereelen.)

1929 **625 .251 (.494)**
Spoor- en Tramwegen, nr 3, 5 Februari, p. 78.
De invoering van de **doorloopende luchtdrukrem voor goederentreinen** bij de Zwitsersche Bonds- Spoorwegen. (1 300 woorden & fig.)

1929 **385. (07.4 (.492)**
Spoor- en Tramwegen, nr 3, 5 Februari, p. 84.
ASSELBERGHS (H.). — Het Nederlandsch **Spoorwegmuseum** en zijn reorganisatie. (1 800 woorden & fig.) (Slot volgt.)

In Polish.

Inzynier Kolejowy. (Warszawa.)

1929 **624 .6 (.44)**
Inzynier Kolejowy, 1 Stycznia, str. 7.
BALICKI (Z.). — Budowa dwóch najwiekszych w swiecie mostow sklepionyck (dokonczenie). (4 300 slowa & rys.)

1929 **385 .113 (.438)**
Inzynier Kolejowy, 1 Stycznia, str. 23:
SZTOLCMAN (S.). — Polskie Koleje Panstwowe w 1927 r. (1 000 slowa & 7 tablice.)

In Portuguese.

Gazeta dos Caminhos de Ferro. (Lisboa.)

1929 **385 .15 (.460)**
Gaz. dos caminhos de ferro, nº 986, 16 de janeiro, p. 19.
de SOUZA (J. Fernando). — A nova Companhia de Oeste de Espanha. (900 palavras.)

1929 **725 .31 (.469)**
Gaz. dos caminhos de ferro, nº 986, 16 de janeiro, p. 23.
A nova estaçao do Terreiro do Paço. A morte duma **estaçao historica.** (2 500 palavras & fig.)

Revista das Estradas de Ferro. (Rio de Janeiro.)

1928 **625 .13 (.81)**
Revista das Estradas de ferro, nº 83, 30 de dec., p. 698.
LINS (J. C. M.). — **Viaducto do Retiro.** (3 300 palavras, 14 cuadros & fig.)

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[016 .385 (02]

I. — BOOKS.

In French.

1929 725. (02

AUCAMUS, ingénieur des Arts et Manufactures.

Agendas Dunod pour 1929 : **Bâtiment.**

Paris (6e), Dunod, éditeur, 92, rue Bonaparte. (10 × 15 cm.) (Prix : 17 francs.)

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Agendas Dunod pour 1929 : **Travaux Publics.**

Paris (6e), Dunod, éditeur, 92, rue Bonaparte. (10 × 15 cm.) (Prix : 17 francs.)

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Paris (6e), Dunod, éditeur, 92, rue Bonaparte. (10 × 15 cm.) (Prix : 17 francs.)

1929 625 .25 (02

FISSETTE (J.), machiniste-instructeur à Liége.

Cours de frein. Description raisonnée de tous les organes des freins Westinghouse et Knorr.

Bruxelles. Ecole Centrale d'Etudes professionnelles du Syndicat National du Personnel des Ch. P. T. T. M. A. de Belgique, 9-11, place Fontainas. (13 × 20 cm.), de 299 pages, fig. et planches. (Prix : 45 francs belges.)

1929 621 .13 (07 & 621 .138.5 (07

GANDIBLEU (François), agent de surveillance des Chemins de fer de l'Etat belge.

Cours de **technologie de la locomotive et des ateliers de réparation.**

Bruxelles. Ecole Centrale d'Etudes professionnelles du Syndicat National du Personnel des Ch. P. T. T. M. A. de Belgique, 9-11, place Fontainas. (13 × 20 cm.), de 585 pages avec 335 fig. (Prix : 85 francs belges.)

1929 621 .134.5

GANDIBLEU (François), agent de surveillance des Chemins de fer de l'Etat belge.

Le graissage des locomotives modernes.

Bruxelles. Ecole Centrale d'Etudes professionnelles du Syndicat National du Personnel des Ch. P. T. T. M. A. de Belgique, 9-11, place Fontainas. (14 × 21 cm.), de 56 pages avec 35 fig. (Prix : 4 francs belges.)

1929 621 .13 (07

GANDIBLEU (François), agent de surveillance des Chemins de fer de l'Etat belge.

Recueil de 220 questions et réponses-modèles sur les **locomotives.**

Bruxelles. Ecole Centrale d'Etudes professionnelles du Syndicat National du Personnel des Ch. P. T. T. M. A. de Belgique, 9-11, place Fontainas. (22 × 28 cm.) (Prix : 45 francs belges.)

1928 624. (02

Les ponts. Hier. Aujourd'hui. Demain et l'esthétique des ponts.

Paris, Le Moniteur des Travaux Publics de l'Entreprise et de l'Industrie. Deux brochures in-4° (315 × 245 cm.), de 74 p., avec 155 fig. et 8 p. avec 15 fig.

1929 62. (07

Notes et formules du chef d'atelier et de l'ouvrier.

Paris, Albin Michel, éditeur, 22, rue Huyghens 726 pages, 511 fig. (Prix : 50 francs.)

1929 721 .9

PERBAL (L.).

Tableaux relatifs à la **construction métallique.** Documentation pratique immédiatement utilisable par tous ceux qui ont à s'occuper du **calcul et de la construction des charpentes métalliques.**

Paris (6e). Dunod, 92, rue Bonaparte. Un vol. (21 × 27 cm.) de 80 p. avec 13 fig. Cartonnage spécial. (Prix : 23 francs.)

[1] The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibliographique International, of Brussels. See « Bibliographical Decimal Classification as applied to Railway Science », by L. WEISSENBRUCH in the number for November, 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

1929 385. (02

PLACE (Pierre), ingénieur principal à l'Office Central d'études de matériel de chemin de fer.

Agendas Dunod pour 1929 : Chemins de fer.

Paris (6e), Dunod, éditeur, 92, rue Bonaparte. (10 × 15 cm.) (Prix : 17 francs.)

1928 385 .517.6 & 385 .587

SALMONT (André), directeur de l'Office d'Hygiène industrielle et de Médecine sociale.

Les services de **médecine** et **d'hygiène** industrielles et l'organisation scientifique du travail.

Paris. Comité National de l'Organisation Française. (13.5 × 21 cm.), 16 pages. (Prix : 5 francs.)

1929 625 .6 (06

UNION INTERNATIONALE DE TRAMWAYS, DE CHEMINS DE FER D'INTERET LOCAL ET DE TRANSPORTS PUBLICS AUTOMOBILES.

Comptes rendus détaillés du XXIe Congrès International, Rome 6-13 mai 1928.

Bruxelles, Secrétariat Général de l'Union, 112, rue du Trône. In-4°, 848 pages avec de nombreuses figures dans le texte et planches.

In German.

1929 621 .138.2

GOTTSCHALK (M.).

Fördermittel zum Bekohlen und Besanden von Lokomotiven. Eine Untersuchg. d. bestehenden Anlagen in wirtschaftlicher u. technischer Hinsicht..

Leipzig. Verlag von Johann Ambrosius Barth. 8°, VIII, 173 Seiten mit 58 Abb. (Preis : 7 Rm.)

1929 621. (02

RÖTSCHER (F.).

Die Maschinenelemente. Ein Lehr- und Handbuch für Studierende, Konstrukteure und Ingenieure. 2. (Schluss-) Band.

Leipzig. Verlag von Johann Ambrosius Barth. 4° XX, 601-1354 Seiten mit Abb. 1043-2296. (Preis geb. : 48 Rm.)

1929 621 .43

SEILIGER (M.).

Kompressorlose Dieselmotoren und Semidieselmotoren.

Leipzig. Verlag von Johann Ambrosius Barth. Gr. 8°, VI, 296 Seiten mit 340 Abb. und 50 Zahlentafeln im Text. (Preis geb. : 37.50 Rm.)

In English.

1928 385 .587. (02

ALFORD (L. P.).

Laws of management applied to manufacturing.

New York. Ronald Press Co. (6 × 9 inches), 266 pages. (Price : $ 4.00.)

1929 656 .25 (06 (08 (.73)

AMERICAN RAILWAY ASSOCIATION. Signal Section.

Advance Notice. Thirty-fifth annual meeting. Stevens Hotel, Chicago, Ill. March 4 and 5, 1929.

New York. Published by the Signal Section, A. R. A., 30 Vesey Street. 422 pages, tables & fig.

1928 656 (.73)

ATTERBURY (W. W.).

Linking rail and air transport.

Philadelphia, Pa. Published by Pennsylvania Railroad. Apply.

1929 659 (.42)

BENNETT (E. P. Leigh).

Come abroad with us. Illustrated by Leonard RICHMOND.

London. Published by the Southern Railway. 1 vol. (8 3/4 × 10 3/4 inches) of 116 pages. (Price : 2 sh. 6 d.)

1928 625 .4 (.42 + .44)

COLLARD (William).

Proposed London and Paris Railway : London and Paris in 2 hours 45 minutes.

London, P. S. King & Son Ltd., Orchard House, Westminster. 1 vol. (10 × 7 1/2 inches) of 292 pages with map. (Price : 10 sh. 6 d.)

1928 385 .587. (02

CORNELL (William B.).

Industrial organization and management.

New York. Ronald Press Co. (6 × 9 inches), 653 pages, illus., graphs, forms. (Price : $ 5.00.)

1929 621 .89

DOVER (M. V.).

Tests on lubricating oils.

Columbia, Mo. University of Missouri. Paper (6 × 9 inches), 52 pages, illustrated, plates and tables.

1929 621 .392 & 665 .882

GILLESPIE (P.), HUGHES (C. A.), JACKSON (K. B.) and FOX (J. H.).

Structural Welding Committee of the American Bureau of Welding : Report on **pilot tests** at the University of Toronto, 1927-28.

Sec. 2. Bulletin 8, School of Engineering Research, Paper (6 × 9 inches), 72 pages, illustrations and tables. Also **Shear Stress in certain thin fillets**, by the same authors, being Sec. 3 of same Bulletin. Paper (6 × 9 inches), 6 pages, illustrated.

1929 656 .223.2 (.73) & 656 .235.3 (.73)

HARTMAN (Harleigh H.).

Law and theory of railway demurrage charges.

New York. Published by Traffic Publishing Company, 150, Lafayette Street. (6 × 9 inches), 200 pages. (Price : $ 5.00.)

1929 385. (09.3 (.73)

HUNGERFORD (Edward).

The story of the Baltimore & Ohio Railroad 1827-1927.

New York. Published by C. P. Putnam's Sons. 2 vols. Illustrations, maps, diagrams. (Price : $ 10.00.)

1928 625 .142.3

HUGHES (F. S.).

Note on steel sleeper design. Technical Paper No. 260.

Calcutta. Government of India Central Publication Branch. (Price : 14 annas or 1 sh. 6 d.)

1929 385

NEOPIHANOFF (A. A.).

Certain tendencies in the development of world railway affairs. Reprinted from Manchuria Monitor, nº 10, 1928.

Harbin (Manchuria). Published by Printing Office of the Chinese Eastern Railway. 70 pages.

1929 625 .4 (.73)

New Cascade tunnel, Great Northern Railway. Brief history of project, comparison with other large tunnels, engineering and construction features and program of coast to coast broadcasting of the dedication exercises, in a form extremely convenient for reference purposes.

St. Paul, Minn. Published by Great Northern Ry. Co. 20 pages and a map. (Apply.)

1929 656 .212. (09 (.73)

Opening of Pennsylvania terminal at Little Creek, Norfolk, Virginia, January 10, 1929.

Philadelphia, Pa. Published by Pennsylvania Railroad. 12 pages.

1929 385. (09.3 (.73)

Over a century of railroading. A brief analytical history of the Baltimore & Ohio Railroad.

New York. Published by National City Company. 32 pages, illust. Apply.

1929 62. (01 & 691

PARKINSON (G. A.), FINCH (S. P.) and HOFF (J. E.).

Portland cement mortar, relation between strength and temperature at time of test.

Austin, Texas. University of Texas. Paper (6 × 9 inches). 26 pages, line cuts.

1929 62. (01

POORMAN (Alfred P.), A. B., C. E., professor of applied mechanics, Purdue University, Lafayette, Ind.

Strength of materials.

New York and London : McGraw-Hill Book Co. Second edition. (6 × 9 inches), 343 pages, 214 illustrations, mostly line cuts. (Price : $ 3.)

1928 625 .253. (06 (08 (.73)

Proceedings of the Air Brake Association. (Convention held at Detroit. Mich. May 1 to 4, 1928.)

New York, Air Brake Association, 165, Broadway. 1 vol. (6 × 8 1/2 inches), of 382 pages, illustrated. Bound in black leather.

1928 621 .133.1 (06 (08 (.73)

Proceedings of the International Railway Fuel Association. (Convention held at Chicago, May 8 to 11, 1928.)

Chicago. International Railway Fuel Association, 313, Railway Exchange. 1 vol. (6 × 9 inches), 564 pages, illustrated. Flexible red binding.

1928 385

SHERRINGTON (C. E. R.).

The Economics of Rail Transport in Great Britain.

London, Edward Arnold & Co., 2 volumes in-8º (5 1/4 × 8 1/2 inches) with tables & figures in the text. Vol. I : History and development, 283 pages. Vol. II : Rates and service, 332 pages. (Price : 12 sh. 6 d. per volume, obtainable separately.)

1929 624 .1 & 721 .1

SIMPSON (William).

Foundations. The examination and testing of the ground preliminary to the construction of works. Methods and appliances.

London. Constable and Co., Ltd. (Price : 18 sh. net.)

1929 385 ,15 (.3)

SPLAWN (Walter M. W.).

Government ownership and operation of railroads.

New York. Published by the Macmillan Company. (8 1/2 × 5 3/4 inches), 478 pages. (Price : $ 5.)

1929 62

TIMOSHENKO (S.).

Vibration problems in engineering.

New York, D. Van Nostrand and Company, Inc.

1929 625 .4 (.42) & 656 .2 (.42)

THOMAS (J. P.), M. I. E. E., M. Inst. T.

Handling London's Underground traffic.

London, S. W. 1. Underground Railways, 55, Broadway, Westminster. (8 1/4 × 6 inches), 237 pages. (Price : 7 sh. 6 d. net.)

1929 614 .8 (.73)

1928 Transactions of the National Safety Council, Steam Railroad Section. Series of papers on prevention of railroad accidents of all kinds.

Chicago, Ill. Published by National Safety Council. 95 pages.

1929 693 & 721 .9

VAUGH (Mason).

Reinforced brickwork.

Columbia, Mo. University of Missouri. Paper (6 × 9 inches), 84 pages. 68 illustrations and 33 tables.

In Italian.

1928 656. (06 (.45)

Primo convegno nazionale degli institori e dei dirigenti delle aziende di trasporto. Roma, 10-11-12 ottobre 1928-VI. Atti ufficiali.

Città di Castello. Tipografia dell' « Unione Arti Grafiche ». (17.5 × 25 cm.), 232 pagine.

1929 385 .21 (06 (.45)

Primo convegno nazionale di navigazione interna Venezia. 21-22-23 ottobre 1928-VI. Atti ufficiali.

Città di Castello. Tipografia dell' « Unione Arti Grafiche ». (17.5 × 25 cm.), 129 pagine.

[016 .385. (05]

II. — PERIODICALS.

In French.

Annales des Chemins de fer et Tramways. (Paris.)

1929 656 .284 (.44)

Ann. des ch. de fer et tramw., janv.-fév., 3e ple, p. 1.

Note sur la question de la responsabilité des chemins de fer en matière d'incendie de propriétés riveraines. (2 300 mots.)

Arts et Métiers. (Paris.)

1929 624 .1

Arts et Métiers, janvier, p. 4.

PEZANT (P.). — Les systèmes à articulations à treillis statiquement indéterminés. (1 900 mots & fig.)

1929 624 .1

Arts et Métiers, janvier, p. 9.

CHIROL (H.). — Méthode graphique pour la détermination des flèches dans les poutres en treillis simples. (2 700 mots, 2 tableaux & fig.)

1929 621 .135.1

Arts et Métiers, janvier, p. 26.

MERCOYROL (A.). — De l'aération de l'abri des locomotives pour faciliter au personnel la traversée des longs tunnels des lignes accidentées. (1 000 mots & fig.)

Bulletin de la Société d'encouragement pour l'industrie nationale. (Paris.)

1928 385. (07.1

Bull. de la Soc. d'enc. pour l'ind. nat., déc., p. 933.

FRÉMONT (Ch.). — La formation des apprentis. (2 700 mots & fig.)

Bulletin des transports internationaux par chemins de fer. (Berne.)

1929 658 .28 (01

Bull. des transp. intern. par ch. de fer, février, p. 40.

SCHMID (E.). — La responsabilité des chemins de fer en cas de mort ou de blessures de voyageurs, d'après la législation de différents Etats. (2 000 mots.)

1929 313 .385 (.489)

Bull. des transp. intern. par ch. de fer, février, p. 83.

Statistique des chemins de fer danois pour l'exercice 1927-1928. (600 mots & 1 tableau.)

Chronique des transports. (Paris.)

1929 385 .113 (.43)

Chronique des transports, n° 2, 25 janvier, p. 2.

Le huitième rapport du Commissaire des Chemins de fer allemands. (5 500 mots.)

1929 385. (09 (.44)

Chronique des transports, n° 3, 10 février, p. 2.

Les Chemins de fer d'Alsace-Lorraine et l'Administration française. (1 800 mots.)

1929 385. 387 (.44)

Chronique des transports, n° 3. 10 février, p. 6.

La taylorisation dans les Chemins de fer français. (2 100 mots.)

Génie civil. (Paris.)

1929 385. (01 (.66)

Génie civil, n° 2426, 9 février, p. 133.

BLACK (J.-B. de). — Les projets de chemin de fer transsaharien et la mise en valeur de l'Afrique occidentale française. (5 800 mots & 2 cartes.)

1929 621 .4

Génie civil, n° 2426, 9 février, p. 139.

DANTIN (Ch.). — Le moteur Rupa à combustion interne à charbon pulvérisé. (2 800 mots & fig.)

1929 721 .4

Génie civil, n° 2426, 9 février, p. 148.

MESNAGER. — Le flambement des arcs. Arcs circulaires surbaissés ou non. (500 mots.)

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Génie civil, n° 2427, 16 février, p. 157.

Le groupe turbo-alternateur de 110 000 kw. de la Brooklyn Edison Co., à New-York. (2 300 mots & fig.)

1929 62. (01 & 721 .5

Génie civil, n° 2427, 16 février, p. 164.

BOUTRY (P.). — Calcul des fatigues dans une section de béton armé soumise à la flexion composée. (1 600 mots & fig.)

1929 62. (01 & 669

Génie civil, n° 2427, 16 février, p. 167.

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Génie civil, n° 2427, 16 février, p. 169.

Le nouveau chemin de fer funiculaire de Naples. (1 100 mots & fig.)

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Génie civil, n° 2428, 23 février, p. 184.

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Génie civil, n° 2428, 23 février, p. 190.

Le traitement des eaux d'alimentation des chaudières à hautes pressions. (2 100 mots.)

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Génie civil, n° 2428, 23 février, p. 193.
Traverse en béton armé pour voies ferrées, système Emperger. (700 mots & fig.)

La Science et la Vie. (Paris.)

1929 656 .211.7 (.73)
La Science et la Vie, mars, p. 187.
Un ferry-boat à ponts multiples capable de contenir 95 wagons vient d'être mis en service en Amérique. (600 mots.)

Les Chemins de fer et les Tramways (Paris.)

1929 656 .211.7
Les chemins de fer et les tramways, février, p. 25.
DUCHESNOY. — Les ferry-boats. (2 300 mots & fig.)

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Les chemins de fer et les tramways, février, p. 27.
GUIRAUD (E.). — La désherbeuse « R. E. P. ». (2 000 mots & fig.)

1929 621 .132.8
Les chemins de fer et les tramways, février, p. 30.
SPIESS (E.). — Locomotives à vapeur articulées à grande puissance. (5 000 mots, 4 tableaux & fig.)

1929 621 .132.8 (.43) & 621 .133.1 (.43)
Les chemins de fer et les tramways, février, p. 40.
Une nouvelle locomotive allemande pour chauffage à charbon pulvérisé. (560 mots & fig.)

1929 625 .143.5
Les chemins de fer et les tramways, février, p. 42.
Procédé de fixation par soudage de la selle sur les traverses en fer. (1 300 mots & fig.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

1929 621 .8 (.44)
L'Ind. voies ferrées et transp. autom., janvier, p. 17.
DELAUNE (J.). — Organisation des manutentions dans les ateliers de la Société des Transports en commun de la Région parisienne. (5 200 mots & fig.)

1929 625 .614
L'Ind. voies ferrées et transp. autom., janvier, p. 36.
RIEDEL. — Perfectionnements apportés aux voies (aiguillage électrique). Rapport présenté au XXI^e Congrès international (Rome, 6-12 mai 1928). (4 200 mots & fig.)

1929 625 .62
L'Ind. voies ferrées et transp. autom., février, p. 67.
BIETTE. — La circulation des tramways. Procédés graphiques pour la détermination des horaires. (4 000 mots & fig.)

1929 625 .62 (.44)
L'Ind. voies ferrées et transp. autom., février, p. 76.
MARIAGE (A.). — Le nouveau système de perception des places du Réseau Départemental des Transports en commun de la Région parisienne. (3 800 mots & fig.)

Revue C. F. F. (Berne).

1929 656 .211 (.494)
Revue C. F. F., n° 2, 15 février, p. 24.
GENOUD (A.). — La nouvelle gare de Fribourg. (1 300 mots & fig.)

Revue générale des chemins de fer. (Paris.)

1929 621 .138.2 (.44)
Revue générale des ch. de fer, février, p. 85.
RICHON. — Elévateur-culbuteur pour distribution de combustibles. (2 200 mots & fig.)

1929 621 .138.1 (.44) & 725 .33 (.44)
Revue générale des ch. de fer, février, p. 91.
HEMERY. — Reconstruction des dépôts de locomotives du Réseau du Nord après la guerre. (5 000 mots, 1 tableau & fig.)

1929 656 .254 (.43)
Revue générale des ch. de fer, février, p. 114.
La téléselection automatique par courants alternatifs dans les installations téléphoniques des Chemins de fer allemands. (5 900 mots & fig.)

1929 385 .113 (.438)
Revue générale des ch. de fer, février, p. 127.
Résultats de l'exploitation des Chemins de fer de l'Etat polonais pour l'exercice 1927. (Tableaux.)

1929 385 .113 (.71)
Revue générale des ch. de fer, février, p. 129.
Les résultats de l'exploitation du « Canadian National Railway » en 1926 et en 1927. (2 800 mots.)

1929 385 .113 (.73)
Revue générale des ch. de fer, février, p. 133.
Les résultats de l'exploitation des chemins de fer des Etats-Unis en 1927. (3 200 mots.)

1929 656 .212.5
Revue générale des ch. de fer, février, p. 138.
La technique du triage. (1 600 mots & fig.)

1929 656 .23
Revue générale des ch. de fer, février, p. 141.
Les variations du trafic et l'exploitation des chemins de fer allemands. (3 000 mots & fig.)

1929 625 .24 (.436)
Revue générale des ch. de fer, février, p. 149.
Essais de transports de très longues pièces chargées sur wagons ordinaires. (2 300 mots & fig.)

1929 669 .1 (.43)
Revue générale des ch. de fer, février, p. 152.
Un nouvel **acier de construction à haute résistance.** (250 mots.)

Revue politique et parlementaire. (Paris.)

1929 385. (09.1 (.43 + .44)
Revue politique et parlementaire, 10 février, p. 341.
PAYEN (E.). — **La situation des grands réseaux français.** Un discours du Ministre des Travaux publics. Les chemins de fer allemands. (5 600 mots.)

Revue Universelle des Mines. (Liége.)

1929 385 .587
Revue universelle des Mines, n° 5, mars, p. 131.
HAIDANT (P.). — **L'organisation scientifique du travail et la rationalisation.** (5 000 mots.)

In German.

Elektrotechnische Zeitschrift. (Berlin.)

1929 621 .31 (.52)
Elektrotechnische Zeitschrift, Heft 7, 14 Februar, S. 226.
HULDSCHINER (G.). — Die japanische **Elektrowirtschaft und Elektroindustrie.** (3 400 Wörter, 2 Tafeln & Abb.)

1929 621 .33 (.494)
Elektrotechnische Zeitschrift, Heft 8, 21. Februar, S. 270.
Stand der **Elektrisierung** bei den Schweizer Bundesbahnen. (200 Wörter & Tafel.)

Glasers Annalen. (Berlin.)

1929 62. (01
Glasers Annalen, Heft 3, 1. Februar, S. 33.
MOSER (M.). — Die Verfahren der neuzeitigen **mechanischen Werkstoffprüfung.** (2 400 Wörter & Abb.)

1929 621 .133.7
Glasers Annalen, Heft 3, 1. Februar, S. 40.
JULIUSBURGER. — **Abdampfvorwärmer und Abdampfinjektor.** (4 800 Wörter, 1 Tafel & Abb.) (Schluss folgt.)

In English.

Bulletin American Railway Engineering Association. (Chicago.)

1929 725 .3 (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 313, January, p. 549.
Report of Committee VI. — **Buildings.** (13 000 words.)

1929 657. (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 313, January, p. 575.
Report of Committee XI. — **Records and accounts** (35 000 words & fig.)

1929 691. (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 313, January, p. 653.
Report of Committee XVII. — **Wood preservation.** (13 000 words & fig.)

1929 656 .2 (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 313, January, p. 703.
Report of Committee XXI. — **Economics of railway operation.** (25 000 words, tables & fig.)

1929 693. (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 313, January, p. 781.
Report of Committee VIII. — **Masonry.** (12 000 words, tables & fig.)

1929 625 .111. (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 313, January, p. 817.
Report of Committee XVI. — **Economics of railway location.** (10 000 words, tables & fig.)

1929 625 .1 (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 314, February, p. 893.
Report of Committee V. — **Track.** (17 000 words, tables & fig.)

1929 624 .92 (06 (08 (.73) & 721 .9 (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 314, February, p. 953.
Report of Committee XV. — **Iron and steel structures.** (44 000 words & fig.)

1929 385 .586. (06 (08 (.73) & 385 .587. (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 314, February, p. 1105
Report of Committee XXII. — **Economics of railway labor.** (16 000 words & tables.)

1929 624 .2 (06 (08 (.73) & 624 .91 (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 314, February, p. 1145
Report of Committee VII. **Wooden bridges and trestles.** (30 000 words.)

1929
Bull. Amer. Ry. Eng. Ass[on], No. 314, February, p. 1228
Progress report of special committee on **stresses in railroad track.** (400 words.)

1929 385. (07 (.73)
Bull. Amer. Ry. Eng. Ass[on], No. 314, February, p. 1229
Report of Committee XXIV. — **Co-operative relation with universities.** (650 words.)

Electric Railway Journal. (New-York.)

1929 621 .336 (.43)
Electric Railway Journal, No. 4, January 26, p. 150
Double trolley catenary construction. (300 words & fig.)

1929 **621 .338 (.73)**
Electric Railway Journal, No. 4, January 26, p. 157.
FREY (George). — New group of **standardized cars** designed (six for city service and two for interurban). (2 400 words, 3 tables & fig.)

1929 **621 .4 (.73)**
Electric Railway Journal, No. 4, January 26, p. 165.
QUEENEY (J. A.). — Philadelphia Rapid Transit Co., to use **fuel oil for buses.** (3 100 words & fig.)

1929 **656 .225 (.73) & 656 .233 (.73)**
Electric Railway Journal, No. 5, February 2, p. 192.
McCLOY (J. W.). — **Freight business** offers possibilities in Central States (3 400 words, 1 map & fig.)

1929 **625 .14 (.73)**
Electric Railway Journal, No. 5, February 2, p. 203.
JACOBS (R. H.). — **Concreted track** for New York City **Subway.** (3 000 words & fig.)

1929 **656 .254 (.73)**
Electric Railway Journal, No. 5, February 2, p. 207.
Power supervising grows with Chicago Rapid Transit System. (1 700 words & fig.)

1929 **656 .254 (.73)**
Electric Railway Journal, No. 5, February 2, p. 212.
London **tape recorder** faster than telephone. (600 words.)

1929 **625 .4 (.73)**
Electric Railway Journal, No. 6, February 9, p. 241.
New Philadelphia **subway.** (5 300 words & fig.)

1929 **625 .26 (.73)**
Electric Railway Journal, No. 7, February 16, p. 273.
SQUIER (C. W.). — Special inspection increases **shop efficiency.** (2 800 words & fig.)

Engineer. (London.)

1929 **621 .165**
Engineer, No. 3812, February 1, p. 136.
GUY (H. L.). — Tendencies in **steam turbine development.** (To be continued.) (4 800 words, 2 tables & fig.)

1929 **624 .2 (.42)**
Engineer, No. 3813, February 8, p. 150.
The **Bridge Stress** Committee's report. (4 800 words.)

1929 **621 .165**
Engineer, No. 3813, February 8, p. 152.
GUY (H. L.). — Tendencies in **steam turbine development.** (Concluded.) (4 800 words, 7 tables & fig.)

1929 **621 .132.8 (.56 + .81)**
Engineer, No. 3813, February 8, p. 156.
Two new **rail cars** for Overseas. (1 700 words & fig.)

1929 **625 .216**
Engineer, No. 3815, February 22, p. 216.
The Boirault **automatic coupler.** (1 800 words & fig.)

1929 **625 .1 (.71)**
Engineer, No. 3815, February 22, p. 220.
Railway constructional activity in Western Canada. (1 600 words.)

1929 **669**
The Metallurgist, p. 17, Supplement to the Engineer, No. 3815, February 22.
Gases in metals. (1 300 words.)

1929 **669 .1**
The Metallurgist, p. 21, Supplement to the Engineer, No. 3815, February 22.
Manganese and sulphur in steel. (1 100 words & fig.)

1929 **669 .1**
The Metallurgist, p. 23, Supplement to the Engineer, No. 3815, February 22.
ROBERTSON (A.) & NEWPORT (A. J.). — The stress-strain diagrams of a heat treated **nickel-chrome steel.** (1 400 words & fig.)

1929 **669 .1**
The Metallurgist, p. 29, Supplement to the Engineer, No. 3815, February 22.
High-tensile structural steels. (650 words.)

1929 **656 .283 (.42)**
Engineer, No. 3816, February 29, p. 241.
The Charfield **railway accident.** (1 900 words.)

1929 **621 .133.1**
Engineer, No. 3816, February 29, p. 244.
SAMS (J. G. B.). — **Locomotive coal tests.** (1 700 words.)

Engineering. (London.)

1929 **621 .165**
Engineering, No. 3290, February 1, p. 148.
GUY (H. L.). — **Tendencies in steam turbine development.** (To be continued.) (5 000 words, 4 tables & fig.)

1929 **624 .62 (.42)**
Engineering, No. 3291, February 8, p. 156.
The **reconstruction of the Wearmouth Bridge,** Sunderland. (2 400 words & fig.)

1929 **536**
Engineering, No. 3291, February 8, p. 179.
NÄGEL (A.). — The **transfer of heat in reciprocating engines.** Chapter II. (To be continued.) (5 700 words, 3 tables & fig.)

1929 **621 .39 (.42) & 621 .9 (.42)**
Engineering, No. 3291, February 8, p. 182.
Portable universal **electric tool.** (1 100 words & fig.)

1929 621 .165
Engineering, No. 3291, February 8, p. 183.
GUY (H. L.). — **Tendencies in steam turbine development.** (Concluded.) (4 500 words, 7 tables & fig.)

1929 624 .2 (.42)
Engineering, No. 3292, February 15, p. 187.
Impact on railway bridges (concluded). (3 900 words, 8 tables & fig.)

1929 385. (.61)
Engineering, No. 3292, February 15, p. 211.
Railways in Morocco. (1 700 words & 1 map.)

1929 621 .331 (.68)
Engineering, No. 3292, February 15, p. 212.
3 000-volt **automatic sub-station equipment** for the South African Railways (to be continued). (3 400 words & fig.)

1929 621 .116 (.73)
Engineering, No. 3292, February 15, p. 217.
Pulverised-fuel boiler tests at the Calumet Station, Chicago. (1 000 words & 1 table.)

1929 621 .132.8 (.43) & 621 .133.1 (.43)
Engineering, No. 3293, February 22, p. 219.
The use of **pulverised fuel** on the German State Railways. (2 000 words & fig.)

1929 385 .113 (.68)
Engineering, No. 3293, February 22, p. 239.
South African Railways and Harbours. (1 800 words.)

1929 621 .94 (.42)
Engineering, No. 3293, February 22, p. 244.
The Multi-Biax flexible-drive **grinding machine.** (350 words & fig.)

1929 536
Engineering, No. 3294, March 1, p. 279.
NÄGEL (A.). — **The transfer of heat** in reciprocating engines. — III. (4 800 words & fig.) (To be continued.)

1929 621 .31 (.68)
Engineering, No. 3294, March 1, p. 282.
3 000-volt automatic **sub-station equipment** for the South African Railways. (1 900 words & fig.)

Engineering News-Record. (New-York.)

1929 691
Engineering News-Record, No. 5, January 31, p. 172.
JOHNSON (N. C.). — **Concrete.** — Chapter II : **Commercial production** of concrete. (To be continued.) (4 500 words.)

1929 691
Engineering News-Record, No. 5, January 31, p. 176.
MAC LEAN (J. D.). — **Absorption of wood preservatives.** (2 700 words, 4 tables & fig.)

1929 62. (01 & 691
Engineering News-Record, No. 5, January 31, p. 179.
WILEY (C. C.). — **Effect of temperature on the strength of concrete.** (1 800 words & fig.)

1929 624 .51 (.73)
Engineering News-Record, No. 5, January 31, p. 187.
MARTIN (Lloyd L.). — **Suspension bridge tower erection** at Detroit by creeper traveler. (2 800 words & fig.)

1929 62. (08 (.73)
Engineering News-Record, No. 6, February 7, p. 221.
Some **construction projects of 1928.** A pictorial survey. (fig.)

1929 691
Engineering News-Record, No. 7, February 14, p. 263.
JOHNSON (N. C.). — **Concrete.** — Chapter III : **Simplifying quality production.** (To be continued.) (5 900 words, 2 tables & fig.)

1929 721 .1
Engineering News-Record, No. 7, February 14, p. 270.
Geophysical methods **for subsoil studies in foundation work.**
I. CROSBY (I. B.) and KELLEY (S. F.). — **Electrical subsoil exploration** and the civil Engineer. (2 700 words, 1 table & fig.)
II. PARSONS (A. T.). — **Geophysical foundation study by explosion wave method.** (1 900 words & fig.)

1929 691. (06 (08 (.73)
Engineering News-Record, No. 8, February 21, p. 300.
Concrete problems discussed at Detroit. (4 800 words.)

1929 693 & 721 .9
Engineering News-Record, No. 8, February 21, p. 304.
LENT (L. B.). — Possibilities **for reinforced brickwork.** (1 900 words & fig.)

1929 691
Engineering News-Record. No. 8, February 21, p. 314.
JOHNSON (N. C.). — **Concrete.** — Chapter IV : Effecting economies by study of cements. (4 500 words & fig.)

Journal of the Institution of Engineers, Australia. (Sydney.)

1929 621 .392 (.945) & 625 .13 (.945)
Journal Institution of Engineers Australia, Jan., p. 9.
CHAPMAN (W. D.). — **Strengthening of Echuca bridge** by electric **welding.** (5 000 words, 4 tables & fig.)

Journal of the Institute of Transport. (London.)

1929 656
Journal of the Institute of Transport, Feb. p. 202.
HAMMOND (F. D.). — **Some transport problems of the (British) Empire.** (12 000 words.)

1929 656 .2 (.73)
Journal of the Institute of Transport, Feb., p. 218.
SHERRINGTON (C. E. R.). — Latest developments in American railway practice. (7 500 words & fig.)

1929 656
Journal of the Institute of Transport, Feb. p. 229.
SMITH (R. F.). — Co-ordination. (3 800 words.)

1929 656 .1 (.82)
Journal of the Institute of Transport, Feb., p. 233.
HAMMOND (A. A.). — The possibilities of road transport in the Argentine Republic. (3 200 words & 2 tables.)

Journal, Permanent-Way Institution. (London.)

1928 625 .144.4
Journal, Perm.-Way Inst., december, p. 179.
TAZEWELL (B.). — Lifting and packing. (1 900 words.)

1928 625 .144.4
Journal, Perm.-Way Inst., december, p. 185.
CARN (A.). — Lifting and packing. (1 500 words & fig.)

1928 625 .1 (.44)
Journal, Perm.-Way Inst., december, p. 190.
WILLOX (W. A.). — Recent french railway construction. New railways on the P. L. M. through the Cevennes and the Maritime Alps. (3 000 words & fig.)

1928 625 .113
Journal, Perm.-Way Inst., december, p. 201.
BASSINDALE (H. H.). — Adjustment of curves. (1 900 words.)

1928 625 .142.2
Journal, Perm.-Way Inst., december, p. 206.
RUTTER (H.). — Timber waybeams on bridges and staiths. (2 600 words & fig.)

Locomotive Railway Carriage & Wagon Review. (London.)

1929 621 .132.8 (.73)
Loc. Ry. Carriage & Wagon Review, Febr. 15, p. 37.
Articulated oil-burning locomotives, Southern Pacific Railroad. (600 words & fig.)

1929 621 .132.1 (.593)
Loc. Ry. Carriage & Wagon Review, Febr. 15, p. 41.
Recent locomotives for the Royal State Rys. of Siam. (1 100 words & fig.)

1929 621 .132.5. (.86)
Loc. Ry. Carriage & Wagon Review, Febr. 15, p. 46.
Three-cylinder locomotives, Colombian Government Rys. (2 600 words & fig.)

1929 621 .95 (.42)
Loc. Ry. Carriage & Wagon Review, Febr. 15, p. 60.
« Kearns » universal boring machine for machining injector bodies. (800 words & fig.)

1929 656 .221
Loc. Ry. Carriage & Wagon Review, Febr. 15, p. 63.
SHIELDS (T. H.). — Train resistance and tractive effort. (700 words & fig.)

1929 656 .254 & 656 .259
Loc. Ry. Carriage & Wagon Review, Febr. 15, p. 64.
New combined driver's valve for steam and vacuum brakes. (900 words & fig.)

Mechanical Engineering. (New-York.)

1929 51. (08 & 621 .116
Mechanical Engineering, February, p. 109.
KEENAN (J. H.). — A revised Mollier chart for steam, extended to the critical point. (2 300 words, 1 table & fig.)

1929 536
Mechanical Engineering, February, p. 116.
HECK (R. C. H.). — A general steam equation? (3 700 words & fig.)

1929 621 .116
Mechanical Engineering, February, p. 123.
Progress in steam research. (6 000 words, 3 tables & fig.)

1929 621 .132.8 & 621 .165
Mechanical Engineering, February, p. 133.
DOLENGO-KOZEROVSKY (V. P.). — The development of turbo-locomotives. (6 000 words, 1 table & fig.)

Modern Transport. (London.)

1929 385. (09 (.42)
Modern Transport, No. 517, February 9, p. 3.
British Railway position. — A noteworthy review. (2 200 words.)

1929 656 .256.3 (.945)
Modern Transport. No. 517, February 9, p. 9.
Automatic signalling in Australia. Interesting installation on a single line section. (1 200 words & fig.)

1929 385 .113 (.436)
Modern Transport, No. 517, February 9, p. 11.
Austrian railways. Improvements under Company management. (1 000 words & fig.)

1929 38 (.42 + .44)
Modern Transport, No. 518, February 16, p. 3.
SZLUMPER (G. S.). — Cross-Channel traffic. Relative advantages of ferries, tunnels and steamships. (To be continued.) (2 000 words.)

1929 625 .232 (.71)
Modern Transport, No. 518, February 16, p. 6.
New **refreshment cars** for Canadian National Railways. (900 words & fig.)

1929 656 .223.2 (.42) & 656 .233 (.42)
Modern Transport, No. 518, February 16, p. 7.
WHITE (O. J.). — **Mineral traffic working.** Proposals aiming at greater efficiency and economy. (1 700 words.)

1929 614 .8 (.42) & 656 .283 (.42)
Modern Transport, No. 519, February 23, p. 3.
Some lessons of the **Charfield disaster.** (3 000 words.)

1929 625 .1 (.42)
Modern Transport, No. 519, February 23, p. 4.
Engineering works on the Southern Railway. — No 1. — New construction entailed by electrification. (1 600 words.)

1929 625 .4 (.42 + .44)
Modern Transport, No. 519, February 23, p. 6.
The Channel Tunnel. Institute of Transport discussion. (3 000 words.)

1929 385 .4
Modern Transport, No. 519, February 23, p. 9.
PICK (F.). — **Transport administration.** Some reflections on organization. (2 400 words.)

1929 656 .1
Modern Transport, No. 519, February 23, p. 13.
OSLER (J. B.). — **Road transport** for goods haulage. Choice of a suitable vehicle. (1 500 words.)

1929 385 .113 (.54)
Modern Transport, No. 520, March 2, p. 4.
Indian railway progress (1927-1928). (1 900 words.)

1929 625 .1 (.42)
Modern Transport, No. 520, March 2, p. 6.
Engineering works on the Southern Railway. No. 2. — London Area and South Coast. (2 600 words & fig.)

1929 625 .4 (.42) & 656 .211 (.42)
Modern Transport, No. 520, March 2, p. 9.
Reconstruction of Charing Cross Underground Railway station. (1 100 words & fig.)

1929 621 .132.8 (.42)
Modern Transport, No. 520, March 2, p. 11.
Geared steam locomotives for industrial services (Atkinson-Walker units). (900 words & fig.)

1929 625 .1 (0
Modern Transport. No. 520, March 2, p. 13.
QUARTERMAINE (A. S.). — Railways and civil engineering. **New construction and maintenance methods.** (2 000 words.)

Proceedings, American Society of Civil Engineers. (New-York.)

1929 62. (01 & 721 .3
Proceed. Amer. Soc. Civil Eng., February, p. 357.
Progress report of the special committee on **steel column research.** (22 600 words & 38 tables.)

Proceedings, Institution of Mechanical Engineers. (London.)

1928 627 (.42) & 656 .213 (.42)
Proceed. Instit. of Mechanical Engineers, No. 3, p. 551.
WENTWORTH (F. E.). — The **port** of Southampton. (9 000 words & fig.)

1928 621 .8
Proceed. Instit. of Mechanical Engineers, No. 3, p. 659.
SWIFT (H. W.). — **Power transmission by belts** : an investigation of fundamentals. (14 500 words, 2 tables & fig.)

Railway Age. (New-York.)

1929 625 .4 (.73)
Railway Age, No. 4, Section one, January 26, p. 233.
Great Northern **breaks records** in tunnel project. (2 400 words & fig.)

1929 656 .262 (.73) & 725 .35 (.73)
Railway Age, No. 4, Section one, January 26, p. 237.
Rock Island improves **commissary organization** and facilities. (2 300 words & fig.)

1929 621 .132.5 (.73)
Railway Age, No. 4, Section one, January 26, p. 241.
Central Vermont receives ten **2-10-4 type locomotives.** (700 words, 1 table & fig.)

1929 656 .253 (.73)
Railway Age, No. 4, Section one, January 26, p. 243.
Traffic facilitated by signals on the Missouri Pacific. (2 000 words & fig.)

1929 625 .235 (.73)
Railway Age, No. 4, Section one, January 26, p. 246.
Steel and composition flooring for **passenger cars.** (600 words & fig.)

1929 621 .335 (.73) & 621 .4 (.73)
Railway Age, No. 4, Section one, January 26, p. 247.
Motor cars handle Cincinnati Northern passenger traffic. (700 words & fig.)

1929 625 .4 (.73)
Railway Age, No. 4, Section one, January 26, p. 249.
Chicago freight speeded up by **underground railroad.** (1 800 words & fig.)

1929 385 .2 (.73) & 385 .3 (.73)
Railway Age, No. 4. Section one, January 26, p. 251.
Joint **barge-and-rail rates** are prescribed. (2 400 words.)

1929 385 .517 (.73)
Railway Age, No. 4. Section one, January 26, p. 254.
Santa Fe reading rooms. (900 words & fig.)

1929 656 .1 (.73)
Railway Age, No. 4, Section two, January 26, p. 275.
What results from motor coach operation? (5 200 words & fig.)

1929 656 .1 (.73)
Railway Age, No. 4, Section two, January 26, p. 280.
Baltimore & Ohio opens new motor coach terminal. (1 500 words & fig.)

1929 656 .261 (.73)
Railway Age, No. 4, Section two, January 26, p. 285.
Rock Island finds tractors and trailors valuable. (2 000 words & fig.)

1929 347 .763 (.73)
Railway Age, No. 4, Section two, January 26, p. 295.
New Interstate regulation bill. (3 400 words.)

1929 656 .255 (.73)
Railway Age, No. 5, February 2, p. 304.
Texas & Pacific saves 30 minutes per train. (1 800 words & fig.)

1929 625 .142.2 (.73) & 691 (.73)
Railway Age, No. 5. February 2, p. 307.
Wood Preservers consider ways to improve practices. (4 700 words & table.)

1929 625 .2 (01 & 656 .281
Railway Age, No. 5, February 2, p. 311.
GOODWIN (E. G.). — Friction vs. roller side bearings in derailments. (1 900 words.)

1929 621 .132.3 (.71)
Railway Age, No. 5, February 2. p. 313.
Canadian Pacific builds two 4-8-4 type locomotives. (2 400 words, 1 table & fig.)

1929 385 .3 (.73) & 656 .233 (.73)
Railway Age, No. 5, February 2, p. 317.
Hearing on new express plan. (2 600 words.)

1929 656 .262 (.73)
Railway Age. No. 5, February 2, p. 319.
Pennsylvania's dining car schools lower cost of meals. (1 900 words & fig.)

1929 625 .162 (.73) & 656 .254 (.73)
Railway Age, No. 6, February 9, p. 349.
Solving the country's most acute grade crossing problem. (3 400 words & fig.)

1929 621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)
Railway Age, No. 6, February 9, p. 353.
Rock Island keeps eye on material waste. (3 700 words, 1 table & fig.)

1929 656 .1 (.73)
Railway Age, No. 6, February 9, p. 358.
Transcontinental motor coach service tested. (5 600 words.)

1929 625 .245 (.73)
Railway Age, No. 6, February 9, p. 363.
Northern Pacific builds new dynamometer car. (3 000 words & fig.)

1929 656 .222.6 (.73)
Railway Age. No. 6, February 9, p. 367.
Better operation, better maintenance, less overtime. (3 000 words & fig.)

1929 621 .139 (.73) & 656 .212.6 (.73)
Railway Age, No. 7, February 16, p. 399.
MILLER (J. V.). — Milwaukee finds profit in lift-truck operations. (2 500 words & fig.)

1929 385 .1 (.73) & 385 .3 (.73)
Railway Age, No. 7, February 16, p. 403.
HALE (H. E.). — What is depreciation? (4 200 words.)

1929 656 .258 (.73)
Railway Age, No. 7, February 16, p. 407.
Automatic protection for gauntlet track on the Louisville & Nashville. (1 100 words & fig.)

1929 621 .133.1
Railway Age, No. 7, February 16, p. 413.
ROBINSON (W. L.). — Problems concerning locomotive fuel. (2 400 words & fig.)

1929 385 .4 (.73) & 625 .261 (.73)
Railway Age, No. 7, February 16, p. 419.
Hearing on container service. (3 600 words.)

Railway Engineer. (London.)

1929 621 .135. (01 (.42) & 621 .135.2 (.42)
Railway Engineer, March, p. 91.
Flanges of locomotive tyres. (1 200 words & fig.)

1929 625 .232 (.82)
Railway Engineer, March, p. 95.
New steel coaches for the Central Argentine Railway. (700 words & fig.)

1929 621 .93 (.42)
Railway Engineer, March, p. 97.
New locomotive frame plate cutting machine at Swindon Works, Great Western Ry. (1 000 words & fig.)

1929 621 .85 (.43) & 725 .43 (.43)
Railway Engineer, March, p. 101.
The works and products of the Demag Aktiengesellschaft. (3 400 words.)

1929 625 .4 (.42 + .44)
Railway Engineer, March, p. 104.
DENDY MARSHALL (C. F.). — The proposed London to Paris railway. (1 600 words.)

1929 621 .134.1 (.54)
Railway Engineer, March, p. 105.
Removal of **tight piston valves.** (250 words & fig.)

1929 621 .132.6 (.73)
Railway Engineer, March, p. 106.
New suburban **tank locomotives** for the Boston & Albany Railroad. (800 words & fig.)

1929 624 .2 (.42)
Railway Engineer, March, p. 108.
Report of the **Bridge Stress Committee.** (4 400 words & fig.)

1929 625 .254 (.42) & 625 .259 (.42)
Railway Engineer, March, p. 115.
Synchronising **steam and automatic vacuum brakes.** (800 words & fig.)

Railway Engineering & Maintenance. (Chicago.)

1929 621 .133.7 (.73)
Railway Engineering and Maintenance, February, p. 46.
Treating a low-hardness water saves $48 000 per annum (Chicago, Rock Island & Pacific). (2 200 words & fig.)

1929 625 .162 (.73) & 656 .254 (.73)
Railway Engineering and Maintenance, February, p. 51.
Meeting the challenge of the highway. (3 700 words & fig.)

1929 693
Railway Engineering and Maintenance, February, p. 56.
PALMER (L. A.). — **What is efflorescence?** How it can be prevented and cured. (2 700 words & fig.)

1929 625 .142.2 (.73) & 691 (.73)
Railway Engineering and Maintenance, February, p. 60.
Making timber last longer. (1 500 words & fig.)

1929 625 .17 (.73)
Railway Engineering and Maintenance, February, p. 63.
MORSE (C. A.). — Better **maintenance of way** at lower cost. (3 300 words & fig.)

1929 625 .142.2 (.73) & 691 (.73)
Railway Engineering and Maintenance, February, p. 66.
SHIPLEY (G. B.). — Where are we heading in **timber preservation?** A survey of recent trends in treating practices and the use of protected wood. (3 100 words & fig.)

Railway Gazette. (London.)

1929 385 .111 (.42)
Railway Gazette, No. 6, February 8, p. 181.
British **railway accounts and returns.** (2 000 words.)

1929 656 .231 (.43)
Railway Gazette, No. 6, February 8, p. 183.
BERGMANN (C.). — The German State Railway and its **rate policy.** (1 300 words.)

1929 625 .1 (.54)
Railway Gazette, No. 6, February 8, p. 184.
The **Bhore Ghat realignment,** Great Indian Peninsula Railway. (1 500 words & fig.)

1929 621 .132.8 (.81)
Railway Gazette, No. 6, February 8, p. 187.
« Sentinel- Cammell » **steam rail inspection car** for the Leopoldina Railway. (900 words & fig.)

1929 621 .132.3 (.62) & 621 .132.5 (.62)
Railway Gazette, No. 6, February 8, p. 191.
New 2-6-0 type locomotives for the Egyptian State Railways. (500 words & fig.)

1929 38 (.42 + .44)
Railway Gazette, No. 7, February 15, p. 213.
Cross-Channel traffic working. (2 500 words.)

1929 656 .223.2 (.42) & 656 .233 (.42)
Railway Gazette, No. 7, February 15, p. 215.
Mineral traffic working. (1 300 words.)

1929 [illegible] .1
Railway Gazette, No. 7, February 15, p. 218.
Motor transport in British dependencies. (700 words.)

1929 656 .254 (.42)
Railway Gazette, No. 8, February 22, p. 245.
Traffic control on the London Midland & Scottish Railway. (3 700 words, tables & fig.)

1929 385 .4
Railway Gazette, No. 8, February 22, p. 263.
Organization of **transport undertakings.** (1 300 words.)

1929 621 .33 (.42)
Railway Gazette, No. 8, February 22, p. 264.
Southern Railway **electrification.** (700 words & map.)

1929 656 .1 (.41) & 656 .2 (.41)
Railway Gazette, No. 8, February 22, p. 266.
Road-rail transport in Ireland. (500 words & fig.)

1929 625 .258 (.44) & 656 .259 (.44)
Railway Gazette, No. 9, March 1, p. 291.
Deloison system at La Délivrance **marshalling yard,** Lille. (Electrically controlled **shoe braking system.**) (2 500 words & fig.)

1929 625 .4 (.42) & 656 .211 (.42)
Railway Gazette, No. 9, March 1, p. 297.
The new Charing Cross « **Underground** » **station.** (1 000 words & fig.)

Railway Magazine. (London.)

1929 385. (09.1 (.66)
Railway Magazine, March, p. 175.
TAYLOR (G.). — **The Gold Coast Government Railways.** (Central provinces line). (1 600 words & fig.) (To be continued.)

1929 656 .222.1 (.42)
Railway Magazine, March, p. 203.
ALLEN (C. J.). — British locomotive practice and performance. (5 700 words, 3 tables & fig.)

Railway Mechanical Engineer. (New-York.)

1929 621 .132.5 (.73)
Railway Mechanical Engineer, February, p. 56.
Heavy 2-8-8-4 type locomotive for the Northern Pacific (« Yellowstone » type). (3 600 words & fig.)

1929 621 .133.7
Railway Mechanical Engineer, February, p. 72.
OSTERMAN (R. M.). — The characteristics of injectors. The utility of exhaust steam injectors as locomotive feedwater heaters (Part I). (4 800 words, 3 tables & fig.)

1929 625 .26 (.73)
Railway Mechanical Engineer, February, p. 78.
Boston and Maine centralized freight car repairs at Concord, N. H. (4 100 words & fig.)

1929 625 .2 (0 (.73)
Railway Mechanical Engineer, February, p. 87.
NYSTROM (K. F.). — How to reduce bad order cars. (4 200 words & fig.)

1929 625 .26 (.73)
Railway Mechanical Engineer, February, p. 91.
Painting and handling sash. (500 words & fig.)

1929 621 .138.5 (.73) & 625 .26 (.73)
Railway Mechanical Engineer, February, p.
ROBINSON (Lee). — Illinois Central Paducah repair shop meets expectations (Part I). (2 700 words & fig.)

Railway Signaling. (Chicago.)

1929 656 .253 (.73)
Railway Signaling, February, p. 41.
Louisville, Henderson & St. Louis semaphore signals. (1 700 words & fig.)

1929 656 .253 (.73)
Railway Signaling, February, p. 44.
BENDER (F. W.). — Central of New Jersey installs code train stop with cab and wayside signals. (3 200 words & fig.)

1929 656 .258 (.73)
Railway Signaling, February, p. 49.
New York Central expands electric plant by adding 3 levers. (2 900 words & fig.)

1929 656 .253 (.73)
Railway Signaling, February, p. 53.
Santa Fe installs color-light signals in desert territory. (2 000 words & fig.)

1929 656 .258 (.73)
Railway Signaling, February, p. 56.
ANDERSON (E. W.). — Nashville, Chattanooga & St. Louis consolidates two interlockers, saving $ 6 000 a year. (750 words & fig.)

1929 656 .255 (.73)
Railway Signaling, February, p. 58.
Southern Pacific cuts freight train time more than a minute per mile. (2 800 words, tables & fig.)

1929 656 .254 (.73)
Railway Signaling, February, p. 62.
Automatic crossing signals used in congested district. (2 800 words & fig.)

1929 656 .256 (.73)
Railway Signaling, February, p. 65.
LONGWELL (R. L.). — Automatic switching for railway signal service. (2 800 words & fig.)

South African Railways and Harbours Magazine. (Johannesburg.)

1929 725 .33 (.68)
South African Rys. & Harbours Mag., January, p. 29.
Foundation stones of the new railway station laid by the Hon. C. W. Malan, M. L. A., Minister of railways and harbours. (2 800 words & fig.)

1929 385. (09.1 (.54)
South African Rys. & Harbours Mag., January, p. 45.
WAGSTAFF (H. W.). — The North-Western Railway of India. (6 000 words & fig.)

1929 385 .113 (.68)
South African Rys. & Harbours Mag., January, p. 117.
A year of records on the South African Railways and Harbours. General Manager's report for the year ended 31st March, 1928. (2 000 words.)

University of Illinois Bulletin. (Urbana.)

1929 697
University of Illinois Bulletin, No. 188, Jan. 8, p. 9.
WILLARD (A. C.), KRATZ (A. P.) and DAY (V. S.). — Investigation of warm-air furnaces and heating systems. Part III. (15 000 words, 9 tables & fig.)

In Spanish.

Gaceta de los Caminos de hierro. (Madrid.)

1929 656 .1 & 656 .2
Gaceta de los Cam. de hierro, n° 3574. 1° de feb., p. 37.
El ferro-carril y el automóvil. (1 500 palabras.)

1929 621 .132.8 & 621 .335
Gaceta de los Cam. de hierro, n° 3575, 10 de feb., p. 49.
Nueva locomotora turboelectrica. (Continuará.) (1 500 palabras.)

Revista de Obras Públicas. (Madrid.)

1929 **624 .63 (.460)**

Revista de Obras Públicas, nº 2519, 15 de febrero, p. 65.

CAMÓN (J.). — **Construccion del puente sobre el Ebro, en Mequinenza (Zaragoza), en la carretera de Maella a Fraga** (Continuara). (2 500 palabras, 2 cuadros y fig.)

1929 **625 .112 (.460)**

Revista de Obras Públicas, nº 2519, 15 de febrero, p. 69.

MACHIMBARRENA (V.). — **El ancho de via de los ferrocarriles españoles. — I.** Reseña histórica (Continuara). (3 100 palabras.)

1929 **691**

Revista de Obras Públicas, nº 2519, 15 de febrero, p. 76.

LOPEZ FRANCO (A.). — **Análisis microscópicos de cementos.** (2 100 palabras y fig.)

1929 **624 .63 (.460)**

Revista de Obras Públicas, nº 2520, 1º de marzo, p. 85.

CAMÓN (J.). — **Construccion del puente sobre el Ebro, en Mequinenza (Zaragoza), en la carretera de Maella a Fraga.** (2 400 palabras, cuadros & fig.)

In Italian.

Rivista tecnica delle ferrovie italiane. (Roma.)

1929 **624 .32 (.45)**

Rivista tecnica delle ferrov. ital., 15 gennaio, p. 1.

MAZZONI (A.). — **Del montaggio di un particolare ponte in ferro sul fiume Adda presso Morbegno** (Valtellina). (2 300 parole & fig.)

1929 **669**

Rivista tecnica ferrov. ital., 15 gennaio, p. 9.

STECCANELLA (A.). — **I laminati al rame.** (1 600 parole & tabella.)

In Dutch.

De Ingenieur. (Den Haag.)

1929 **656**

De Ingenieur, nr 6, 9 Februari, p. T. 5.

SIMON-THOMAS (W.). — **Economische regeling van het verkeerswezen.** I. (10 000 woorden & fig.)

1929 **656**

De Ingenieur, nr 6, 9 Februari, p. T. 18.

HEG (R.). — **Economische regeling van het verkeerswezen.** II. (1 500 woorden.)

1929 **656**

De Ingenieur, nr 7, 16 Februari, p. T. 21.

SWAAB (L.). — **Economische regeling van het verkeerswezen.** III. (6 300 woorden & 5 tabelen.)

1929 **656**

De Ingenieur, nr 7, 16 Februari, p. T. 30.

BURGERSDIJK (W. J.). — **Economische regeling van het verkeerswezen.** IV. (5 000 woorden, 4 tabelen & fig.)

De Locomotief. (Amsterdam.)

1929 **655**

De Locomotief, nr 6, 6 Februari, p. 42.

De plaatskaartenpers voorheen en thans. (600 woorden & fig.)

1929 **656 .1 & 656 .2**

De Locomotief, nr 7, 13 Februari, p. 49.

Spoorweg of autobus? (2 100 woorden.)

Spoor- en Tramwegen. (Utrecht.)

1929 **621 .132.8**

Spoor- en Tramwegen, nr 4, 19 Februari, p. 113.

ROSENTHAL (G. A.). — **Clayton coaches.** (1 300 woorden & fig.)

1929 **656 .211.7 (.4)**

Spoor- en Tramwegen, nr 4, 19 Februari, p. 116.

Veerdiensten over het Kanaal en boottreinen. (1 700 woorden & fig.)

1929 **385. (07.4 (.492)**

Spoor- en Tramwegen, nr 4, 19 Februari, p. 119.

ASSELBERGHS (H.). — Het Nederlandsch **Spoorwegmuseum** en zijn reorganisatie. (1 100 woorden & fig.)

1929 **385. (09.1 (.71)**

Spoor- en Tramwegen, nr 4, 19 Februari, p. 124.

ETTY-LEAL (M. W.). — **De Canadian Pacific Railway.** De brug tusschen Atlantischen en Indischen Oceaan (slot volgt). (1 200 woorden & fig.)

In Polish.

Inzynier Kolejowy. (Warszawa.)

1929 **625 .17**

Inzynier Kolejowy, 1 Lutego, str. 43.

BYSTRZANOWSKI (Jan). — **Uwagi o reorganizacji systemu pracy w sluzbie drogowej, reorganizacja wydzialów drogowych i podleglych im jednostek.** (3 200 slowa, tablice & fig.)

1929 **621 .132.8 & 621 .4**

Inzynier Kolejowy, 1 Lutego, str. 56.

RYBICKI (A.). — Wynalazki z Dziedziny Kolejnictwa. **Lokomotywa gazowa uniwersalna.** Projekt inz. A. Rybickiego. (4 300 slowa, tablice & fig.)

In Portuguese.

Revista das Estradas de Ferro. (Rio de Janeiro.)

1929 **385. (0**

Revista das Estradas de ferro, nº 84, 15 de Jan., p. 4

NICOLAS (M.). — **A construcção de novas vias ferreas** nos paises novos. (3 000 palavras.)

1929 **625 .232 (.81**

Revista das Estradas de ferro, nº 86, 15 de Fev., p. 5

Carros de aço de grande luxo paro o Brasil. (1 20 palavras & fig.)

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

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(MAY 1929

[016 .385 (02]

I. — BOOKS.

In French.

1929 621 .1 (02

BOULVIN (J.).

Cours de mécanique appliquée aux machines: moteurs animés; récepteurs hydrauliques, récepteurs pneumatiques. 2e volume, 3e édition, mis à jour par C. Monteil.

Paris. Albin Michel, éditeur. 22, rue Huyghens. Un volume de 296 pages avec 192 figures. (Prix: 40 francs.)

1929 313 .385. (05 (.498)

DIRECTION GÉNÉRALE DES CHEMINS DE FER ROUMAINS.

Annuaire statistique des Chemins de fer de l'Etat roumain pour l'année d'exercice 1926.

Bucarest. Tipografia Ion C. Vacarescu, strada Umbrei, No. 4. In-4°. 165 pages, diagrammes et 1 carte.

1929 385. (09.3 (.44)

PARDE (M.).

La restauration des chemins de fer français depuis l'armistice.

Paris. Gauthier-Villars et Cie, éditeurs. In-8°. 32 pages. (Prix : 20 francs.)

In German.

1929 621 .33 (.494)

HUBER-STOCKAR (E.).

Die Elektrifizierung der Schweizerischen Bundesbahnen bis Ende 1928.

Zürich. Herausgegeben von der Naturforschenden Gesellschaft, als Neujahrsblatt 1929. Zu beziehen beim Generalsekretariat des Schweizerischen Elektrotechnischen Vereins, Seefeldstrasse, 301. 1 Band (210 × 297 mm.), 65 Seiten, 1 Karte, 6 Tafeln, 73 Photografien und 15 Textfiguren. (Preis-exkl. Porto : 6 Franken.)

1928 621 .9

HÜLLE (F. W.).

Die Grundzüge der Werkzeugmaschinen und der Metallbearbeitung. Band I : Der Bau der Werkzeugmaschinen.

Berlin. Verlag von Julius Springer. 6. Auflage. 269 Seiten. (Preis geh. : 6.50 Rm.)

1929 62. (01

MAYER (R.).

Knickfestigkeit.

Berlin W. 9. Verlag von Julius Springer. 1 Band, 500 Seiten, mit 280 Abb. und 87 Tabellen. (Preis : 20 Rm.)

1929 621 .43

SEILIGER (M.).

Kompressorlose Dieselmotoren und Semidieselmotoren.

Berlin, W. 9. Verlag von Julius Springer. 1 Band, 296 Seiten mit 340 Abb. und 50 Tabellen. (Preis : 37.50 Rm.)

In English.

1929 62. (01

AMERICAN SOCIETY FOR TESTING MATERIALS.

Index to A. S. T. M. Standards and tentative standards.

Philadelphia. Published by the Association. (6 × 9 inches). 96 pages.

1929 625 .212 & 625 .214

A temperature study of car journals in motion.

Chicago, Ill. Published by Universal Packing and Service Company. 1 pamphlet of 29 pages, charts and tables. Apply.

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibliographique International, of Brussels. See « Bibliographical Decimal Classification as applied to Railway Science », by WEISSENBRUCH in the number for November, 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

1929 625 .235, 625 .27 & 691

BAILEY (W. A.), B. A., I. F. S., timber advisory officer with the Railway Board.

Note on **miscellaneous indigenous timbers considered suitable for railway carriage building with details concerning the storing and seasoning of timber.**

Calcutta. Government of India Central Publication Branch. Technical Paper n° 270. 8vo (6 5/16 × 9 5/8 inches). 12 pages, tables & fig. (Price : Annas 6 or 8 d.)

1929 016 .614.8 (.73) & 016 .656.25 (.73)

Bibliography, street and highway safety. Prepared for the Committee on causes and prevention of highway accidents, Highway Research Board, by the staff of the library of the Bureau of Public Roads.

« Grade crossing accidents on rural highways », p. 35-60. « Traffic legislation » (grade crossings), p. 245-248. « Traffic Control signals and signs » p. 281-288.

Washington, D. C. Distributed by Highway Education Board. 388 p. Apply.

1929 621 .135 (.42) & 625 .212 (.42)

BRITISH ENGINEERING STANDARDS ASSOCIATION.

British standard specification for railway locomotive, carriage and wagon axles. (No. 24. Part 1.)

London, S. W. 1. : Publication Department, British Engineering Standards Association, 28, Victoria Street. (Price : 2 sh. 2 d., post free.)

1929 656 .1 & 656 .2

BRUNNER (Christopher T.), M. A.

Road versus Rail. The case for motor transport.

London E. C. 4. Ernest Benn Limited, Bouverie House, Fleet Street. (8 1/2 × 5 1/2 inches), 128 pages. (Price : 2 sh. 6 d. net.)

1929 621 .33 & 656 .23

BURTT (Philip).

Railway electrification and traffic problems.

London W. C. 2. Sir Isaac Pitman & Sons Ltd., Parker Street, Kingsway. (8 1/2 × 5 1/2 inches), 197 pages. (Price : 10 sh. 6 d. net.)

1929 385. (064 (.931)

Commerce train news 1928.

Wellington, N. Z. Published by General Manager's Office, New Zealand Railways, 46 p. Apply.

1929 625 .1 (.73)

Conquering the Cascades Section.

Seattle, Washington. Published by Railway and Marine News. 1 vol. of 66 pages. with illustrations, maps and tables. (Price : 50 cents.)

1929 656 .23

CRICKER (A. Lane).

Uniform through export bill of lading. Trade information bulletin No. 593. U. S. Department of Commerce. Revised 1928. Washington : Superintendent of Public Documents, Government Printing Office. 62 pages. (Price : 14 cents.)

1929 62. (02

Engineer's Diary for 1929.

London, S. E. 1, Charles Letts & Co., Southwark Bridge Building. (5 1/2 × 3 1/4 inches). (Price : 3 sh.)

1929 621 .13 (02 (.42

Locomotive engineer's pocket book. 1929.

London, E. C. 4. The Locomotive Publishing Compan[y] Ltd., 3, Amen Corner. (Price : 3 sh. 6 d.)

1929 621 .3 ((

« Mechanical World » electrical pocket book, 1929.

Manchester : Emmott & Co. Ltd., 65, King Stree[t] London W. C. 2: 20, Bedford Street. (6 1/4 × 4 inches) 338 pages. (Price : 1 sh. 6 d. net.)

1929 621 .32 & 656 .2[3]

MULLENEUX (H. J.), A. M. I. E. (Ind.). assistant ele[c]trical engineer, Great Indian Peninsula Railway.

Flood-lighting.

Calcutta. Government of India Central Publicati[on] Branch. Technical Paper No. 267. 8vo (6 5/16 × 9 5[/8] inches). 25 pages, tables & fig.

1929 385 .1 (.7[3]

POWELL (T. C.).

Railroad consolidations and unifications (Adventur[e] in benevolent absorption).

Chicago, Ill. Probably available from Chicago & Eas[t]ern Illinois Railway, Co. 40 pages. Apply.

1929 385. ((

Railway Diary & Officials' Directory for 1929.

London. McCorquodale & Co. Ltd., Cardington Stree[t] Euston Square. (6 3/8 × 9 1/4 inches × 1/2 inch) 224 pages. (Price : 3 sh. 6 d.)

1929 669

REED (Everett L.).

Photomicrographs of iron and steel.

New York. John Wiley & Sons (6 × 9 inche[s]) 253 pages, illust. & tables. (Price : $ 4.)

1929 385. (09.2 (.7[3]

REPPLIER (A.).

Pere Marquette. — A fine biography of the explor[er] of the Mississipi river.

Garden City, N. Y. (U. S. A.). Published by Doubl[e]day, Doran & Co. 298 pages. (Price : $ 3.00.)

1929 659 (.4[2]

VALE (Edmund).

The track of the twenty-fives. London Midland [&] Scottish route book No. 5.

London. Obtainable at Euston and bookstal[ls] 52 pages and paper cover. (Price : 1 sh.)

1929 385 (.4[2]

WOOD (W. V.) and SHERRINGTON (C. E. R.).

The Railway Industry of Great Britain, 1927. Speci[al] Memorandum No. 27. London and Cambridge Econom[ic] Service.

Section A : General situation 1923-27; new basis [of] charging; railway systems and their assets; capit[al] expenditure; ancillary services.

Section B : Financial results.

Section C : Miscellaneous statistics; summary [of] present position (January 1929).

London W. C. 2. London School of Economics. Houg[h]ton Street. 1 pamphlet of 27 pages. (Price : 5 sh. net)

In Italian.

1929 — 62. (02

COLOMBO (G.).

Manuale dell' Ingegnere.

Milano, U. Hoepli, 55.-59. edizione, 915 pagine.

1928 — 341 .324 (.45)

LANINO (Pietro), Ing.

Le ferrovie italiane nella guerra italiana 1915-1918.

Edito a cura del Collegio Nazionale degli Ingegneri Ferroviari Italiani, come Supplemento al fascicolo di ottobre 1928 della « Rivista Tecnica delle ferrovie italiane ». Un volume di pag. 121 (21 × 31 cm.) con 11 tavole fuori testo.

[016 .385. (05]

II. — PERIODICALS.

In French.

Annales des Mines. (Paris.)

1928 — 621 .118

Annales des Mines, décembre, p. 398.

Bulletin des accidents d'appareils à vapeur survenus pendant l'année 1927. (Tableau.)

Annales des Ponts et Chaussées. (Paris.)

1929 — 721 .4

Ann. des ponts et chauss., part. techn., nov.-déc., p. 179.

SUQUET. — Pression exercée par les terres sur les voûtes des souterrains. (2 300 mots, 5 tables & fig.)

1929 — 624 .8

Ann. des ponts et chauss., part. techn., nov.-déc., p. 188.

PIETRI. — Etude sur les ponts basculants système Scherzer. (17 000 mots & fig.)

Annales des travaux publics de Belgique. (Bruxelles.)

1929 — 624 .63 (.493)

Ann. des travaux publics de Belgique, février, p. 11.

ROBA (A.). — Le pont en béton armé de Martelange sur la Sûre et les passerelles en béton armé de Frahan et de Mouzaive sur la Semois. (4 300 mots & fig.)

1929 — 624. (06 (.436)

Ann. des travaux publics de Belgique, février, p. 31.

DE CUYPER. — Deuxième Congrès international de la construction des ponts et des charpentes. Note de mission. (2 900 mots.)

1929 — 624. (01

Ann. des travaux publics de Belgique, février, p. 39.

DE CUYPER. — L'esthétique dans la construction des ponts. (2 800 mots.) (A suivre.)

Arts et Métiers. (Paris.)

1929 — 691

Arts et Métiers, février, p. 51.

MARCOTTE (E.). — Contribution à l'étude de la résistance et de l'élasticité des ciments, des mortiers et des bétons. (3 700 mots & 10 tableaux.) (A suivre.)

1929 — 621 .392

Arts et Métiers, mars, p. 87.

LEBRUN (M.). — Applications de la soudure électrique à l'arc. (A suivre.) (6 300 mots & fig.)

Bulletin de la Société d'encouragement pour l'industrie nationale. (Paris.)

1929 — 656 .235.7 (.44)

Bull. de la Soc. d'enc. pour l'ind. nat., janv., p. 41.

Les services agricoles des Compagnies de chemins de fer de Paris à Orléans et de Paris à Lyon et à la Méditerrannée. (9 500 mots.)

Bulletin de la Société des ingénieurs civils de France. (Paris.)

1928 — 621 .43

Bull de la Soc. des ing. civ. de France, sept.-oct., p. 1043.

GARNIER (A.). — L'évolution du moteur Diesel au point de vue de sa construction et de son emploi. (7 700 mots & fig.)

Bulletin des transports internationaux par chemins de fer. (Berne.)

1929 — 313 .385 (.436)

Bull. des transp. intern. par ch. de fer, mars, p. 150.

Statistique des chemins de fer tchécoslovaques pour les exercices 1925 et 1926. (1 100 mots & 1 tableau.)

Bulletin de l'Union internationale des chemins de fer. (Paris.)

1929 — 385 .113 (.44)

Bull. de l'Union intern. des ch. de fer, janv.-fév., p. 1.

Les chemins de fer exploités par l'Etat français. (8 200 mots.)

1929 — 385 .12 (.460)

Bull. de l'Union intern. des ch. de fer, janv.-fév., p. 14.

VILLAMIL. — Création en Espagne du patronage national du tourisme et de l'assurance obligatoire des voyageurs transportés par chemin de fer. (1 500 mots.)

1929 — 385 .113 (.43)
Bull. de l'Union intern. des ch. de fer, janv.-fév., p. 16.
Rapport du Commissaire des Chemins de fer allemands à la Commission des Réparations sur la quatrième année d'application du plan des experts (1er septembre 1927-31 août 1928). (29 500 mots & 33 tableaux.)

Chronique des transports. (Paris.)

1929 — 385 .517.1 (.44)
Chronique des transports, n° 4, 25 février, p. 2.
Chronique des transports, n° 5, 10 mars, p. 2.
Le régime de retraite des agents des Grands Réseaux français. (6 300 mots & 2 tableaux.)

1929 — 656 .224 (.44)
Chronique des transports, n° 6, 25 mars, p. 2.
La nouvelle convention postale. (3 900 mots.)

1929 — 385 .113 (.44)
Chronique des transports, n° 6, 25 mars, p. 9.
Les résultats des grands réseaux en 1928. (1 350 mots.)

Génie civil. (Paris.)

1929 — 656 .211.4 (.44) & 725 .31 (.44)
Génie civil, n° 2429, 2 mars, p. 205.
DANTIN (Ch.). — **Les agrandissements et la transformation de la gare de l'Est, à Paris.** (4 500 mots & fig.)

1929 — 624 .63 (.64)
Génie civil, n° 2429, 2 mars, p. 213.
Le nouveau pont en béton armé de Termast sur l'Oum er Rebia (Maroc). (1 200 mots & fig.)

1929 — 624. (0
Génie civil, n° 2429, 2 mars, p. 219.
L'emploi des aciers au silicium pour la construction des grands ponts. (600 mots.)

1929 — 624. (06 (.436)
Génie civil, n° 2430, 9 mars, p. 233.
DANTIN (Ch.). — **Le IIe Congrès international des ponts et charpentes** (Vienne, 23-27 septembre 1928). (5 000 mots.)

1929 — 621
Génie civil, n° 2430, 9 mars, p. 239.
GORFINKEL (A.). — **Calcul et tracé des cames pour les distributions de moteurs.** (3 500 mots, 2 tables & fig.)

1929 — 624 .63
Génie civil, n° 2430, 9 mars, p. 244.
Le frettage des arcs en béton armé. (1 200 mots & fig.)

1929 — 621 .134.3
Génie civil, n° 2431, 16 mars, p. 266.
Projets de locomotive à vapeur à 60 kg./cm², système Wiesinger. (700 mots & fig.)

1929 — 621 .114
Génie civil, n° 2431, 16 mars, p. 269.
PELTIER (J.). — **Le « sondage magnétique » des arbres de machines.** (700 mots & fig.)

1929 — 721 .4
Génie civil, n° 2432, 23 mars, p. 284.
Résistance des matériaux. Le flambement des arcs. (5 500 mots & fig.)

1929 — 621 .116
Génie civil, n° 2432, 23 mars, p. 289.
Interprétation graphique des bilans thermiques des chaudières. (1 400 mots & fig.)

1929 — 625 .62
Génie civil, n° 2433, 30 mars, p. 316.
La récupération de l'énergie pendant le freinage des tramways par le système Somaini. (650 mots & fig.)

Les chemins de fer et les tramways. (Paris.)

1929 — 625 .13 (.42 + .44)
Les chemins de fer et les tramways, mars, p. 46.
Le tunnel sous la Manche. (1 900 mots & fig.)

1929 — 621 .335 (.71) & 621 .43 (.71)
Les chemins de fer et les tramways, mars, p. 48.
SPIESS (E.). — **Locomotive Diesel-électrique du Canadian National Railway.** (3 100 mots & fig.)

1929 — 621 .132.8 (.86)
Les chemins de fer et les tramways, mars, p. 51.
Locomotive Pacific à trois cylindres. Voie de 0 m. 914 en Colombie. (500 mots & fig.)

1929 — 621 .337
Les chemins de fer et les tramways, mars, p. 53.
Le changement de vitesse système Mylius. (2 900 mots & fig.)

1929 — 656 .212.8
Les chemins de fer et les tramways, mars, p. 56.
LEFEBVRE (M.). — **Le matériel de pesage pour véhicules sur voie ferrée et sa construction.** (3 150 mots & fig.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

1929 — 656 .1 (.44) & 656 .2 (.44)
L'Ind. voies ferrées et transp. autom., mars, p. 94.
BORDAS (F.). — **La liaison par terre et par fer des deux versants des Vosges.** (3 000 mots & cartes.)

1929 — 625 .614
L'Ind. voies ferrées et transp. autom., mars, p. 110.
VAN NOORBEECK. — **Perfectionnements apportés aux voies.** (12 500 mots & fig.)

La Science et la Vie. (Paris.)

1929 691
La Science et la Vie, avril, p. 297.
LABADIE (J.). — De la science du ciment armé est née la métallurgie de la pierre. (4 550 mots & fig.)

1929 625 .13 (.42 + .44)
La Science et la Vie, avril, p. 307.
FOURNIER (L.). — Comment on envisage, au point de vue technique, le percement d'un tunnel sous la Manche. (4 000 mots & fig.)

Revue générale des chemins de fer. (Paris.)

1929 651 (.44) & 313 .385 (.44)
Revue générale des chemins de fer, mars, p. 169.
BOLLE (G.). — Note sur l'utilisation rationnelle des machines à statistique. (14 500 mots & fig.)

1929 385 .113 (.43)
Revue générale des chemins de fer, mars, p. 196.
Les Chemins de fer allemands pendant la quatrième année d'application du plan Dawes (1er septembre 1927-31 août 1928), d'après le rapport n° 8 du Commissaire des Chemins de fer allemands à la Commission des Réparations. (8 000 mots & 6 tableaux.)

1929 621 .13 (.71 + .73), 621 .335 (.71 + .73) & 625 .2 (.71 + .73)
Revue générale des chemins de fer, mars, p. 210.
Construction, entretien et utilisation du matériel roulant aux Etats-Unis et au Canada. (6 500 mots.)

1929 656 (.73)
Revue générale des chemins de fer, mars, p. 225.
La concurrence aux chemins de fer par route, par air et par eau aux Etats-Unis d'Amérique. (4 300 mots.)

1929 621 .138.1 (.434)
Revue générale des chemins de fer, mars, p. 243.
Les nouvelles installations du dépôt de locomotives Heidelberg. (2 000 mots & fig.)

1929 625 .172 (.44)
Revue générale des chemins de fer, avril, p. 265.
PATTE (M.). — Voiture de contrôle des voies de la Compagnie des chemins de fer de l'Est français. (4 500 mots & fig.)

1929 621 .132.6 (.44)
Revue générale des chemins de fer, avril, p. 281.
PORTAL (M.). — Nouvelles locomotives-tenders compound avec surchauffeur de vapeur à quatre essieux couplés et deux bogies de la Compagnie Paris-Lyon-Méditerranée. (2 400 mots & fig.)

1929 625 .232 (.4)
Revue générale des chemins de fer, avril, p. 290.
MÜNTZ. — Les voitures-lits de grand luxe de la Compagnie Internationale des Wagons-Lits. (1 700 mots & fig.)

1929 385 .113 (.45)
Revue générale des chemins de fer, avril, p. 298.
Revue documentaire. B. — Chemins de fer étrangers (Italie). (8 000 mots & fig.)

1929 625 .14 (01
Revue générale des chemins de fer, avril, p. 309.
Les effets du roulement des trains sur la voie courante. (1 650 mots & fig.)

1929 625 .22
Revue générale des chemins de fer, avril, p. 314.
Gabarit portatif pour wagons de chemins de fer. (650 mots & fig.)

1929 625 .231 (.44)
Revue générale des chemins de fer, avril, p. 319.
Dispositif périscopique des nouveaux fourgons métalliques de la Compagnie du Nord. (300 mots & fig.)

Revue politique et parlementaire. (Paris.)

1929 385 .589
Revue politique et parlementaire, 10 mars, p. 425.
TARDY (Marcel). — Le règlement amiable des conflits collectifs du travail. (8 700 mots.)

Revue universelle des mines, de la métallurgie, des travaux publics, des sciences et des arts appliqués à l'industrie. (Liége.)

1929 385. (09.3 (.493)
Revue universelle des mines, n° 6, 15 mars, p. 175.
LAMALLE (U.). — Les origines des chemins de fer belges. (1 400 mots & 1 carte.)

In German.

Elektrotechnische Zeitschrift. (Berlin.)

1929 621 .3
Elektrotechnische Zeitschrift, Heft 9, 28. Feb., S. 294.
TAMELE (K.). — Fortschritte in der industriellen Anwendung der Elektrowärme. (4 000 Wörter & Abb.)

1929 625 .255 & 625 .258
Elektrotechnische Zeitschrift, Heft 12, 21. März, S. 413.
THOMA (H.). — Die Wirbelstromgleisbremse. (3 550 Wörter & Abb.)

1929 625 .62
Elektrotechnische Zeitschrift, H. 12, 21. März, S. xxxix.
Beleuchtung von Strassenbahnhöfen. (850 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1929 621 .133.7
Glasers Annalen, Heft 4, 15. Februar, S. 53.
JULIUSBURGER. — Abdampfvorwärmer und Abdampfinjektor. (4 500 Wörter & Abb.) (Schluss.)

1929 621 .33 & 621 .35
Glasers Annalen, Heft 4, 15. Februar, S. 60.
WINCKLER (R.). — Herstellung und Verwendung elektrischer Akkumulatoren unter besonderer Berücksichtigung elektrischer Fahrzeuge. (3 500 Wörter & Abb.)

1929 625 .246
Glasers Annalen, Heft 5, 1. März, S. 77.
PHILIPP (W.). — Versuch der graphischen Darstellung der Auswirkung der Rationalisierung an Hand eines Beispiels aus dem Waggonbau. (1 700 Wörter & 3 Abb.)

In English.

Bulletin American Railway Engineering Association. (Chicago.)

1929 625 .143. (06 (08 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 315, March, p. 1231.
Report of Committee IV. — Rail. (19 000 words, tables & fig.)

1929 625 .143.3 (08
Bull. Amer. Ry. Eng. Ass^{on}, No. 315, March, p. 3.
CUSHING (W. C.). — Rail and wheel. A critical survey of the physical requirements for steel rails. Part I : Review of mathematical and technical analyses applied to rail design. (Prepared for London Session, 1925, of International Railway Congress Association.) — Part II : A critical survey of the physical requirements for steel rails. — Part III : The genesis of the transverse fissure. (90 000 words, tables & fig.)

1929 625 .113
Bull. Amer. Ry. Eng. Ass^{on}, No. 315, March, p. 295.
CAMPBELL (J. L.). — Translating the physical characteristics of a railway line into straight and level miles and ton mile costs. (5 300 words & 2 tables.)

1929 385 .1 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 315, March, p. 307.
SNOW (J. P.). — Discussion on depreciation in railroad properties. (1 500 words.)

1929 624 .32 (.73)
Bull. Amer. Ry. Eng. Ass^{on}, No. 315, March, p. 311.
HARDING (C. R.). — The Southern Pacific Company's $ 12 000 000 bridge across Suisun Bay. (1 800 words & fig.)

Electric Railway Journal. (New-York.)

1929 621 .338 (.73)
Electric Railway Journal, No. 8, February 23, p. 319.
Philadelphia subway cars designed for speed, safety and convenience. (2 600 words, 1 table & fig.)

1929 625 .143 (.73) & 625 .15 (.73)
Electric Railway Journal, No. 8, February 23, p. 325.
JACOBS (R. H.). — Track materials specially designed for New York City subways. (3 000 words & fig.)

1929 621 .33 (.436 + .494)
Electric Railway Journal, No. 9, March 2, p. 350.
Austro-Swiss electrification progressing rapidly. (4 600 words, tables & fig.)

1929 621 .331 (.73)
Electric Railway Journal, No. 9, March 2, p. 357.
ROSE (H. A.). — Cincinnati, Hamilton & Dayton Railway modernizes power supply. (2 200 words & fig.)

1929 725 .33 (.73)
Electric Railway Journal, No. 9, March 2, p. 362.
Large car yard designed for Dorchester extension. (1 200 words & fig.)

1929 621 .33 (.73) & 625 .4 (.73)
Electric Railway Journal, No. 10, March 9, p. 395.
Electrical equipment specially designed for Philadelphia Subway. (5 000 words & fig.)

1929 621 .33 (.73)
Electric Railway Journal, No. 11, March 16, p. 422.
Erie canal now Rochester's subway. (1 650 words & fig.)

1929 659 (.73)
Electric Railway Journal, No. 11, March 16, p. 427.
Advertising. An active force in selling transportation. (2 300 words & fig.)

1929 621 .33 (.73)
Electric Railway Journal, No. 11, March 16, p. 433.
Electrification program at Philadelphia gains momentum. (2 350 words & fig.)

1929 625 .26 (.73) & 725 .33 (.73)
Electric Railway Journal, No. 12, March 23, p. 465.
Elaborate shop and yard facilities provided for Philadelphia Subway. (2 300 words, fig. & 1 table.)

1929 621 .331 (.73)
Electric Railway Journal, No. 12, March 23, p. 471.
WARD (O. M.). — Maintenance problems with mercury-arc rectifiers. (500 words & fig.)

1929 725 .33 (.73)
Electric Railway Journal, No. 12, March 23, p. 479.
Efficiency of sand drying tested. (700 words & fig.)

Engineer. (London.)

1929 625 .258 (.42) & 656 .259 (.42)
Engineer, No. 3818, March 15, p. 288.
Shunting on railways. (1 500 words.)

1929 669 .1
The Metallurgist, p. 35, supplement to the Engineer, No. 3820, March 29.
ROBERTSON (A.). — The stress-strain diagrams of a heat treated nickel-chrome steel. (1 350 words & fig.)

1929 669 .1
The Metallurgist, p. 38, supplement to the Engineer, No. 3820, March 29.
HANSON. — **Effects of nickel and chromium on cast iron.** (3 300 words & fig.)

1929 669
The Metallurgist, p. 44, supplement to the Engineer, No. 3820, March 29.
Corrosion-fatigue of metals. No. II. (4 500 words & fig.)

1929 621 .132.8
Engineer, No. 3821, April 5, p. 372.
Development of the Ljungström locomotive. No. 1. (To be continued.) (3 400 words, fig. & 4 tables.)

1929 625 .13 (.42)
Engineer, No. 3821, April 5, p. 380.
SIKES (R. C.). — **Reconstruction work at Old Hill tunnel — Great Western Ry.** (800 words & fig.)

Engineering. (London.)

1929 624 .2
Engineering, No. 3295, March 8, p. 312.
GRIBBLE (C.). — **Impact in railway bridges with reference to the report of the Bridge Stress Committee.** (1 400 words & fig.)

1929 621 .392 (.42)
Engineering, No. 3296, March 15, p. 332.
Electric welding plant. (900 words & fig.)

1929 621 .331 (.45) & 627 (.45)
Engineering, No. 3298, March 29, p. 382.
The Limentre hydro-electric installation, Italy. (2 150 words & fig.)

1929 625 .143.3
Engineering, No. 3298, March 29, p. 398.
The detection of flaws in rails. (2 100 words.)

1929 621 .132.8 (.86)
Engineering, No. 3299, April 5, p. 437.
Kitson-Meyer locomotive for the Cundinamarca Railway, Columbia. (600 words & fig.)

Engineering News-Record. (New-York.)

1929 625 .13 (.73)
Engineering News-Record, No. 9, February 28, p. 334.
Driving the Second Cascade Tunnel. (2 600 words, 4 tables & fig.)

1929 725 .31 (.73)
Engineering News-Record, No. 9, February 28, p. 339.
BELCHER (W. E.). — **Old North Station at Boston replaced by a modern structure including a coliseum.** (3 400 words & fig.)

1929 625 .142.3 (.73) & 625 .142.4 (.73)
Engineering News-Record, No. 9, February 28, p. 345.
TRATMAN (E. E. R.). — **Steel and concrete ties: present and future.** (4 300 words, 1 table & fig.)

1929 621 .132
Engineering News-Record, No. 9, February 28, p. 351.
Three new locomotives of unusual size and design. (500 words & fig.)

1929 693
Engineering News-Record, No. 10, March 7, p. 380.
LUCAS (G. L.). — **Concrete's 15-year record on New York subways.** (5 300 words & fig.)

1929 725 .33 (.73)
Engineering News-Record, No. 11, March 14, p. 420.
Engine terminal and shops, Texas & Pacific Railway. (2 250 words & fig.)

1929 621 .392
Engineering News-Record, No. 11, March 14, p. 425.
McKIBBEN (F. P.). — **Major provisions of an arc-welding specification.** (3 900 words & fig.)

1929 625 .13 (.73)
Engineering News-Record, No. 11, March 14, p. 430.
Ingenious bridge erection reduces falsework. (1 800 words & fig.)

1929 691 (.73)
Engineering News-Record, No. 12, March 21, p. 455.
Non-pressure creosoting process gives good results. (850 words.)

1929 621 .392
Engineering News-Record, No. 12, March 21, p. 459.
Welding. — A new tool for the structural fabricator. (2 300 words & fig.)

1929 624 .2
Engineering News-Record, No. 12, March 21, p. 467.
Continuous beam design practice brought up to date. (2 400 words & fig.)

1929 621 .392 (.73)
Engineering News-Record, No. 13, March 28, p. 490.
PRIEST (H. M.). — **Arc-welding practice on a large hotel building.** (1 800 words & fig.)

1929 625 .236
Engineering News-Record, No. 13, March 28, p. 503.
Mechanical car-washers in railway yards. (1 400 words & fig.)

1929 624 .7 (.73)
Engineering News-Record, No. 13, March 28, p. 509.
HODGES (R. M.). — **Rigid-frame construction applied to structural steel.** (1 750 words & fig.)

Great Western Railway Magazine. (London.)

1929 656 .262 (.42)
Great Western Railway Magazine, April, p. 147.
North Bovey Manor as a Great Western Railway Hotel. (770 words & fig.)

Journal of the Institute of Transport. (London.)

1929 38 (.42 + .44)
Journal of the Institute of Transport, March, p. 255.
SZLUMPER (G. S.). — Cross Channel traffic working. — With discussion. (12 000 words.)

1929 656 .212.6 (.42)
Journal of the Institute of Transport, March, p. 276.
ROBERTS (A. H.). — The discharging of grain cargoes at ports, with special reference to the port of Leith. (2 000 words.)

1929 385 .21 (.42)
Journal of the Institute of Transport, March, p. 280.
CAMPBELL (C. D.). — Inland water transport. (2 500 words & 2 tables.)

Locomotive Railway Carriage & Wagon Review. (London.)

1929 621 .132.7 (.54)
Loc. Ry. Carriage & Wagon Review, March 15, p. 71.
Heavy shunting locomotives for the Indian State Rys. (1 300 words, 1 table & fig.)

1929 621 .132.8 (.42)
Loc. Ry. Carriage & Wagon Review, March 15, p. 79.
Light rail units for passenger and freight work. (2 500 words.) (To be concluded.)

1929 621 .132.8 (.83 + .84) & 625 .3 (.83 + .84)
Loc. Ry. Carriage & Wagon Review, March 15, p. 83.
Rack and adhesion-locomotives, Arica-La Paz Ry. (1 100 words & fig.)

Mechanical Engineering. (New-York.)

1929 621 .112 (.4)
Mechanical Engineering, April, p. 266.
LOFFLER (S.). — The use of high-pressure steam in Europe in economic power generation. (2 200 words.)

1929 621 .16
Mechanical Engineering, April, p. 267.
HAVLIČEK (J.). — The high-pressure steam-electric plant of the Witkowitz Collieries, Czechoslovakia. (5 300 words & fig.)

1929 355 (.73)
Mechanical Engineering, April, p. 279.
Military transportation. (680 words.)

1929 669 .1
Mechanical Engineering, April, p. 289.
Heat treatment of carbon and alloy-steel castings. (600 words.)

1929 62. (01 & 669
Mechanical Engineering, April, p. 290.
MOORE (H. F.). — Elastic failure and fatigue failure of metals. (2 200 words & fig.)

Modern Transport. (London.)

1929 385 .0 (.42)
Modern Transport, No. 521, March 9, p. 7.
WEDGWOOD (Sir Ralph). — The outlook for British Railways. (1 800 words.)

1929 621 .33 (.42)
Modern Transport, No. 521, March 9, p. 9.
WALKER (Sir Herbert). — Electrification of the Southern Railway. Some achievements. (700 words & fig.)

1929 656 .23 (.42)
Modern Transport, No. 521, March 9, p. 10.
SELBIE (R. H.). — The development of residential traffic. What the railways are doing. (1 100 words.)

1929 347 .763.4 (.42) & 385 .113 (.42)
Modern Transport, No. 521, March 9, p. 11.
STAMP (Sir Josiah). — Economic consequences of the Railways Act. The position in 1929. (1 700 words.)

1929 656 .1 (.42) & 656 .2 (.42)
Modern Transport, No. 521, March 9, p. 13.
FORD (E.). — Railway-operated road transport. (1 500 words.)

1929 625 .1 (.42)
Modern Transport, No. 521, March 9, p. 14.
Engineering works on the Southern Railway. No. 3. New works in the Isle of Wight. (2 300 words & fig.)

1929 625 .143. (09.3
Modern Transport, No. 521, March 9, p. 19.
Railway trackwork and its development. (1 800 words.)

1929 621 .13 (0 (.42)
Modern Transport, No. 521, March 9, p. 21.
Ten years of locomotive development. (3 500 words.)

1929 38
Modern Transport, No. 521, March 9, p. 23.
MANCE (Sir H. O.). — Empire communications. Some international aspects. (1 200 words.)

1929 656 .25 (0 (.42)
Modern Transport, No. 521, March 9, p. 28.
BOUND (A. F.). — Ten years of railway signalling. Progress and achievements. (2 400 words.)

1929 656
Modern Transport, No. 522, March 16, p. 4.
Social aspect of rail and bus services. (900 words.)

1929 725 .31
Modern Transport, No. 522, March 16, p. 5.
Railway station architecture. (Fig.)

1929 625 .1 (.42)
Modern Transport, No. 522, March 16, p. 7.
Linking-up Victoria & Exchange stations, Manchester. No. 1. Engineering features of an important London Midland & Scottish undertaking. (1 300 words & fig.)

1929 625 .4 (.42)
Modern Transport, No. 522, March 16, p. 8.
CHORLTON (A. E. L.). — Heavy oil engine for rail and road. Characteristics of the compression-ignition unit. (1 400 words.)

1929 625 .1 (.66)
Modern Transport, No. 522, March 16, p. 9.
Noteworthy development on the Sudan Government Railways. Completion of the Haiya-Kassala-Makwar line. (2 300 words & fig.)

1929 656 .253 (.42)
Modern Transport, No. 523, March 23, p. 6.
Linking-up Victoria & Exchange Stations, Manchester. No. 2. Four aspect light signalling installation, London Midland & Scottish Railway. (4 500 words & fig.)

1929 621 .132.3 (.42) & 621 .132.6 (.42)
Modern Transport, No. 523, March 23, p. 9.
Southern Railway locomotive developments. Three-cylinder shunting and 2-6-0 type passenger engines. (1 250 words & fig.)

1929 725 .32 (.43)
Modern Transport, No. 524, March 30, p. 3.
Railway goods depots. Two-story sheds proposed in Germany. (1 400 words & fig.)

1929 656 .23 (.42)
Modern Transport, No. 524, March 30, p. 5.
Charges by rail. Need for simplification. (1 000 words.)

1929 624
Modern Transport, No. 524, March 30, p. 6.
Some notable bridges. (Figures.)

1929 656 .261
Modern Transport, No. 524, March 30, p. 7.
Collection and delivery. — Railway cartage in urban areas. (1 250 words & fig.)

1929 385. (09.1 (.43)
Modern Transport, No. 525, April 6, p. 3.
DORPMUELLER (J.). — Progress on the German railways. (2 200 words & portrait.)

1929 656 .212
Modern Transport, No. 525, April 6, p. 7.
PAYNE (H. W.). — Goods depot operation. (3 000 words & portrait.)

Proceedings, American Society of Civil Engineers. (New-York.)

1929 624 .63 & 721 .4
Proceed. American Soc. Civil Engineers, March, p. 603.
Experimental investigation of concrete arches. Discussion. (9 000 words.)

1929 526
Proceed. American Soc. Civil Engineers, March, p. 619.
Symposium on construction and location surveys. (5 400 words, fig. & tables.)

1929 721 .9
Proceed. American Soc. Civil Engineers, March, p. 649.
Construction plant and methods for concrete buildings. (3 400 words.)

1929 721 .9
Proceed. American Soc. Civil Engineers, March, p. 657.
Construction plant and methods for steel buildings. (2 300 words.)

1929 691
Proceed. American Soc. Civil Engineers, March, p. 663.
Construction plant and methods for concrete bridges. (1 400 words.)

1929 624 .63 & 721 .4
Proceed. American Soc. Civil Engineers, March, p. 711.
Progress report of the Special Committee on concrete and reinforced concrete arches. (3 700 words, 9 tables & fig.)

1929 624 .2
Proceed. American Soc. Civil Engineers, March, p. 727.
Final report of the Special Committee on impact in highway bridges. (6 400 words, 5 tables & fig.)

Railway Age. (New-York.)

1929 625 .13 (.73)
Railway Age, No. 8, February 22, p. 441.
Lehigh Valley completes Musconetcong Tunnel. (4 700 words & fig.)

1929 385. (01 (.73)
Railway Age, No. 8, February 22, p. 458.
The railroads' place in industrial development. (3 200 words & 1 table.)

1929 385 .3 (.73) & 656 .261 (.73)
Railway Age, No. 8, February 22, p. 465.
The Express plan is approved. Necessary authority granted by Interstate Commerce Commission for taking over by railroads of express business. (3 500 words.)

1929 656 .1 (.73)
Railway Age, No. 8, Motor transp. sect., Feb. 23, p. 495.
Southwestern highway systems growing rapidly. (1 700 words & fig.)

1929 656 .1 (.73)
Railway Age, No. 8, Motor transp. sect., Feb. 23, p. 501.
Baltimore and Ohio inaugurates highway service in West Virginia. (1 300 words & fig.)

1929 625 .1 (.73)
Railway Age, No. 9, March 2, p. 517.
Four-tracking on New York Central involves heavy work. (3 800 words & fig.)

1929 656 .258 (.73) & 656 .259 (.73)
Railway Age, No. 9, March 2, p. 523.

ZANE (W. F.). — Controlling an interlocking from a remote point. Chicago, Burlington & Quincy replaces mechanical plant at railroad crossing with electrical equipment controlled from centralized machine 1.5 miles away. (2 200 words & fig.)

1929 625 .232 (.73)
Railway Age, No. 9, March 2, p. 529.

Central of New Jersey inaugurates de luxe coach trains. (1 800 words & fig.)

1929 621 .132.7 (.73) & 621 .335 (.73)
Railway Age, No. 9, March 2, p. 539.

Chicago, Burlington & Quincy tests Mack switching locomotive (30-ton gas-electric). (900 words, 1 table & fig.)

1929 656 .2 (.725)
Railway Age, No. 10, March 9, p. 567.

CHAMBERS (R.). — Southern Pacific of Mexico is developing a new frontier. (6 000 words, fig. & 1 table.)

1929 624 .32 (.73)
Railway Age, No. 10, March 9, p. 575.

HARDING (C. R.). — Suisun Bay bridge to improve San Francisco service. (2 000 words & fig.)

1929 625 .213
Railway Age, No. 10, March 9, p. 578.

SYMINGTON (T. H.). — Freight car truck springs. (2 850 words, fig. & 3 tables.)

1929 625 .13 (0 & 625 .2 (0
Railway Age, No. 11, March 16, p. 608.

HALE (H. E.). — The cost of railroad equipment. (5 100 words & fig.)

1929 621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)
Railway Age, No. 11, March 16, p. 613.

Contract and car-load buying popular upon railroads. (1 800 words & fig.)

1929 625 .162 (.73) & 656 .259 (.73)
Railway Age, No. 11, March 16, p. 617.

PORTER (L. B.). — Crossing protection installed extensively on the Milwaukee. (2 400 words & fig.)

1929 625 .143.3 (.73)
Railway Age, No. 11, March 16, p. 621.

GENNET (Ch. W.). — The rail failure problem. — Will it be solved? (3 700 words & fig.)

1929 625 .243 (.73)
Railway Age, No. 11, March 16, p. 625.

GORMLEY (M. J.). — Heavier box cars prove their worth. (2 500 words & fig.)

1929 656 .24 (.73)
Railway Age, No. 11, March 16, p. 627.

FORD (E. F.). — Hog mortality in hot weather. (950 words.)

1929 621 .138.1 (.73) & 656 .212.5 (.73)
Railway Age, No. 12, Section one, March 23, p. 651.

Norfolk & Western completes improvements at Portsmouth, Ohio. (6 400 words & fig.)

1929 656 .23 (.73)
Railway Age, No. 12, March 23, p. 659.

PARMELEE (J. H.). — The railroad outlook for 1929. (2 850 words & fig.)

1929 621 .335 (.73) & 621 .43 (.73)
Railway Age, No. 12, March 23, p. 663.

DODD (S. T.). — Diesel-electric passenger locomotive for New York Central. (2 650 words & fig.)

1929 385 .15 (.43)
Railway Age, No. 12, March 23, p. 669.

WEIDENHAMMER (R. M.). — Government Ownership in Germany. (4 000 words.)

1929 621 .132.3 (.43) & 621 .134.3 (.43)
Railway Age, No. 12, March 23, p. 672.

LOEFFLER (H.). — The Loeffler high-pressure locomotive. (750 words & fig.)

1929 656 .1 (06 (08 (.73
Railway Age, No. 12, Section two, March 23, p. 695.

Motor transport division A. R. A. meets at St. Louis (13 400 words, fig. & portraits.)

1929 656 .261 (.73)
Railway Age, No. 12, Section two, March 23, p. 708.

Pacific Electric begins store-door collection and delivery. (2 450 words & fig.)

Railway Engineer. (London.)

1929 621 .132.3 (.436
Railway Engineer, No. 591, April, p. 125.

GIESLINGEN (M. E.). — New 2-8-4 type express locomotive for the Austrian Federal Railways. (4 80 words & fig.)

1929 625 .13 (.42
Railway Engineer, No. 591, April, p. 131.

WHITLEY (H. S. R.). — Reconstruction of the lan spans of the Royal Albert bridge, Saltash, Great Western Railway. (3 000 words & fig.)

1929 621 .95 (.42
Railway Engineer, No. 591, April, p. 140.

A heavy-duty drilling and tapping machine. (50 words & fig.)

1929 656 .255 & 656 .25
Railway Engineer, No. 591, April, p. 141.

Improved methods in the operation of single track — I. (4 100 words & fig.)

1929 621 .132.5 (.73
Railway Engineer, No. 591, April, p. 147.

A remarkable Mallet locomotive. (1 800 words & fig

Railway Engineering & Maintenance. (Chicago.)

1929 625 .144.4 (.73) & 625 .17 (.73)
Railway Engineering and Maintenance, March, p. 92.
KNOWLES (C. R.). — **Labor-saving equipment must work to pay its way.** (3 000 words & fig.)

1929 625 .144.4 (.73) & 625 .17 (.73)
Railway Engineering and Maintenance, March, p. 96.
The first requirement. — Keeping equipment in good condition. (3 000 words & fig.)

1929 625 .144.4 (.73) & 625 .17 (.73)
Railway Engineering and Maintenance, March, p. 101.
New York Central keeps the machines on the job. Each division held responsible for the maintenance and operation of its own equipment. (2 800 words & fig.)

1929 625 .144.4 (.73) & 625 .17 (.73)
Railway Engineering and Maintenance, March, p. 104.
Organizing to keep machines busy. (3 500 words & fig.)

1929 625 .144.4 (.73) & 625 .17 (.73)
Railway Engineering and Maintenance, March, p. 109.
Why it takes a good operator to deliver the goods. (4 100 words & fig.)

1929 625 .1 (0 (.73)
Railway Engineering and Maintenance, March, p. 119.
Where are we heading? A few glances into the future, forecasting the trend of developments in the next five years. (3 500 words & fig.)

Railway Gazette. (London.)

1929 621 .33 (.42)
Railway Gazette, No. 10, March 8, p. 337.
The world's greatest suburban electrification. (2 500 words & fig.)

1929 385. (09.1 (.56)
Railway Gazette, No. 10, March 8, p. 343.
HERBERD (F.). — **Transfer of the Iraq Railways.** (1 500 words & fig.)

1929 625 .235 (.42)
Railway Gazette, No. 10, March 8, p. 315.
A new window-raising device. (600 words & fig.)

1929 625 .258 (.42) & 656 .259 (.42)
Railway Gazette, No. 11, March 15, p. 388.
The Froelich hydraulic wagon brake on the London & North Eastern Railway. (2 300 words & fig.)

1929 621 .132.3 (.42) & 621 .132.6 (.42)
Railway Gazette, No. 12, March 22, p. 432.
New locomotives for the Southern Railway. (1 150 words & fig.)

1929 656 .1 (.42)
Railway Gazette, No. 12, March 22, p. 435.
London & North Eastern Ry. road services for the conveyance of merchandise traffic. (700 words.)

1929 656 (.42)
Railway Gazette, No. 12, March 22, p. 436.
Future of industry and trade. — Final report of the Balfour Committee after five years' work. Proposals and conclusions in regard to transport. (2 300 words.)

1929 656 .255 (.945) & 656 .256.3 (.945)
Railway Gazette, No. 13, March 29, p. 463.
Automatic signalling on the Victorian Government Railways. (1 300 words.)

1929 625 .259 (.493)
Railway Gazette, No. 13, March 29, p. 465.
New rail skid for use in sidings.
Particulars of a device known as the double automatic locking block, recently introduced by a Belgian firm and in use in the marshalling yards at Antwerp, Schaerbeek and Arlon. (600 words and fig.)

1929 621 .33 (.73)
Railway Gazette, No. 13, March 29, p. 466.
Cascade tunnel and Great Northern electrification.
Opening of the longest tunnel in America, and completion of electrification programme of the U. S. Great Northern Railway. (1 500 words & fig.)

1929 621 .9 (.42)
Railway Gazette, No. 13, March 29, p. 471.
The Wadkin motor-driven trenching machine. A special wood working machine for railway carriage and wagon shops capable of heavy work at high speed. (580 words & fig.)

1929 659 (.54)
Railway Gazette, No. 14, April 5, p. 494.
Railway publicity in India. (No. 1.) (1 300 words & fig.)

1929 385 .113 (.42)
Railway Gazette, No. 14, April 5, p. 498.
Summarised profit and loss accounts and balance sheets of the four group railway companies. (450 words & 8 tables.)

Railway Magazine. (London.)

1929 385. (09.1 (.66)
Railway Magazine, April, p. 267.
TAYLOR (G.). — **The Gold Coast Government Railways (central provinces line).** (1 100 words & fig.)

1929 656 .222.1 (.42)
Railway Magazine, April, p. 276.
ALLEN (C. J.). — **British locomotive practice and performance.** (5 400 words & fig.)

Railway Mechanical Engineer. (New-York.)

1929 621 .132.3 (.71)
Railway Mechanical Engineer, March, p. 122.
Two 4-8-4 type locomotives built by Canadian Pacific. (3 000 words, fig. & table.)

1929 625 .245 (.73)
Railway Mechanical Engineer, March, p. 126.
Northern Pacific dynamometer car. (4 700 words & fig.)

1929 621 .132.7 (.73)
Railway Mechanical Engineer, March, p. 131.
Examples of recent switch engines of the 0-6-0, 0-8-0 and 0-10-0 types. (Table.)

1929 621 .133.7
Railway Mechanical Engineer. March, p. 132.
OSTERMAN (R. M.). — The characteristics of injectors. Part II. (5 200 words & tables.)

1929 621 .133.8 (.73)
Railway Mechanical Engineer, March, p. 137.
FLINNER (J. D.). — Valve bracket saves space in the cab. (150 words & fig.)

1929 625 .26 (.73)
Railway Mechanical Engineer, March, p. 138.
Milwaukee passenger-car shop work reorganized. (5 300 words, fig. & tables.)

1929 625 .244 (.73)
Railway Mechanical Engineer, March, p. 146.
Passenger-express refrigerator cars. (700 words & fig.)

1929 621 .9 (.73)
Railway Mechanical Engineer, March, p. 153.
Manufacturing and gaging taper frame bolts. Part II. (3 350 words & fig.)

1929 621 .138.5 (.73)
Railway Mechanical Engineer, March, p. 156.
ROBINSON (L.). — Paducah repair shop operation meets expectations. Part II. — Description of the boiler, blacksmith and other shops not in the machine and erecting shop building. (2 750 words, fig. & tables.)

Railway Signaling. (Chicago.)

1929 656 .254 (.73) & 656 .255 (.73)
Railway Signaling, March, p. 81.
RICHARDS (D. W.). — Norfolk & Western speeds up train operation with dispatcher control. (2 000 words & fig.)

1929 656 .253 (.73)
Railway Signaling, March, p. 84.
WEATHERBY (E. P.). — The Texas & Pacific completes 567-mile signal program in six months' time. (1 900 words & fig.)

1929 656 .258 (.73) & 656 .259 (.73)
Railway Signaling, March, p. 89.
ZANE (W. F.). — Interlocking controlled remotely (2 800 words & fig.)

1929 656 .253 (.73)
Railway Signaling. March, p. 93.
THOMAS (G. K.). — Signaling on the Santa Fe w[illegible] include 5 466 track-miles by end of year. (2 800 word & fig.)

1929 656 .255 (.73) & 656 .256.3 (.73)
Railway Signaling, March, p. 99.
Interlocked automatic signals protect gauntlet tr[illegible]k, on Louisville & Nashville. (1 500 words & fig.)

South African Railways and Harbours Maga[illegible]ne. (Johannesburg.)

1929 385. (09.1 (.68)
South Afr. Railw. & Harb. mag., No. 3, March, p. 379.
The railways of Rhodesia. (2 800 words & fig.)

1929 385. (09.1 [illegible]
South Afr. Railw. & Harb. mag., No. 3, March, [illegible]
The Sao Paulo Railway Company (Limited) of B[illegible]zil. (1 500 words & fig.)

In Spanish.

Gaceta de los Caminos de hierro. (Madrid.)

1929 625 .113
Gac. de los Cam. de hierro. nº 3578, 10 de marz., p. 85.
Methodo práctico y rápido para el aliveamiento de curvas. (1 700 palabras.)

Ingenieria y Construcción. (Madrid.)

1929 385. (09.1 (.73)
Ingenieria y construcción, nº 74, Febrero, p. 65.
LEE (Colin K.). — Algunos progresos ferroviarios americanos durante 1928. (1 200 palabras & fig.)

Revista de Obras Públicas. (Madrid.)

1929 625 .112 (.460)
Revista de Obras Públicas, nº 6, 15 de marzo, p. 105.
MACHIMBARRENA (V.). — El anche de via de los ferrocarriles españoles. II. — Memoria del general Echagüe. (2 000 palabras.)

1929 625 .144.4
Revista de Obras Públicas, nº 7, 1º de abril, p. 132.
ANDREU (G. S.). — Asiento mecánico de la vía. (5 450 palabras & fig.)

1929 625 .5 (.460)
Revista de Obras Públicas, nº 7, 1º de abril, p. 137.
GÖNI (S.). — El funicular de Montjuich. (1 500 palabras & fig.)

In Italian.

Annali dei lavori pubblici. (Roma.)

28 624 .63 (.45)

li dei lavori pubblici, novembre, p. 970.

COLA PACILEO (G. C.). — Il ponte di ruoti sulla ara di Avigliano. (8 100 parole, 17 tavole & fig.)

sta delle comunicazioni ferroviarie. (Roma.)

29 625 .236

delle comunic. ferrov., n° 4, 15 febbraio, p. 12.

à che fa per la pulizia dei treni viaggiatori. (1 300 le.)

929 385 (.4 + .5)

delle comunic. ferrov., n° 6, 15 marzo, p. 9.

andi comunicazioni ferroviarie fra l'Europa e (1 250 parole.)

ista tecnica delle ferrovie italiane. (Roma.)

929 624 .63 (.45)

ista tecnica delle ferrovie italiane, n° 2, 15 feb., p. 45.

ANTARELLA (L.). — Il ponte tranviario di Intra. 00 parole & fig.)

In Dutch.

De Ingenieur. (Den Haag.)

929 625 .162 (.43 + .492)

Ingenieur, Nr 12, 23 Maart, p. 27.

STIELTJES (J. J.). — De gelijkvloersche kruising weg en spoorweg. — Een vergelijking tusschen itschland en Nederland. (4 600 woorden & 3 tab.)

De Locomotief. (Amsterdam.)

1929 625 .62 & 656 .2

De Locomotief, Nr 10, 6 Maart, p. 76.

NIEUWENHUIS (J. G. J. C.). — Tram of autobus? (3 100 woorden & 4 tabelen.) (Wordt vervolgt.)

1929 625 .62 & 656 .2

De Locomotief, Nr 11, 13 Maart, p. 81.

NIEUWENHUIS (J. G. J. C.). — Tram of autobus? (2 600 woorden & fig.) (Slot.)

Spoor- en Tramwegen. (Utrecht.)

1929 625 .234

Spoor- en Tramwegen, Nr 5, 5 Maart, p. 142.
Spoor- en Tramwegen, Nr 6, 19 Maart, p. 174.

VAN DER BURG (J. E.). — Electrische verwarming van rijtuigen in internationaal verkeer. (2 000 woorden.)

1929 625 .212

Spoor- en Tramwegen, Nr 5, 5 Maart, p. 147.
Spoor- en Tramwegen, Nr 6, 19 Maart, p. 177.

MESTRAL DE COMBREMONT (P.). — Ervaringen opgedaan bij het op- en afpersen van wielen voor spoorwegrijtuigen. (1 900 woorden, fig. & 1 tafereel.)

1929 625 .174 (.494)

Spoor- en Tramwegen, Nr 6, 19 Maart, p. 189.

Het opruimen van sneeuw bij de Zwitsersche spoorwegen. (600 woorden & fig.)

In Polish.

Inzynier Kolejowy. (Warszawa.)

1929 625 .142.4

Inzynier Kolejowy, 1 Marca, str. 73.

KRÜGER (A. W.). — Podklady kolejowe z zelazobetonu. (4 600 slowa & rys.)

1929 621 .134.3

Inzynier Kolejowy, 1 Marca, str. 81.

OGUREK (O.). — Parowozy wysokoprezne. (5 200 slowa, 6 tablice & rys.)

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[016 .385 (02]

I. — BOOKS.

In French.

1929 621 .91

CHAMPLY (René), ingénieur-mécanicien.

Comment on devient fraiseur.

Paris (6e), Desforges, Girardot & Cie, 27 et 29, quai des Grands-Augustins, 268 pages, 245 figures. (Prix : 25 francs.)

1929 621 .9

CHAMPLY (R.).

Nouvelle encyclopédie pratique des constructeurs mécaniciens, électriciens, chaudronniers. — Tome treizième. **Machines-outils et outillages.**

Paris. Ch. Béranger, éditeur, 15, rue des Saints-Pères. 220 pages et 242 fig. (Prix : broché, 18 francs; cartonné toile, 23 francs.)

1929 385 .3 & 625 .62

DE LA RUELLE (J.), avocat, rédacteur au Ministère des Travaux publics.

Contrôle des chemins de fer et des tramways.

Paris (6e). Dunod, 92, rue Bonaparte. 1 volume (12 × 18 cm.), IV, 554 pages. (Prix : 58 francs.)

1929 621 .7

DRUOT (A.), inspecteur général de l'Enseignement technique.

Cours de technologie d'atelier. 1er volume : Ajustage

Paris (5e), Léon Eyrolles, 3, rue Thénard, 1 volume (22.5 × 34 cm.), 452 pages avec 725 figures. (Prix : 30 francs.)

1929 62. (01

ROY (Louis), professeur à la Faculté des Sciences de Toulouse.

Problèmes de statique graphique et de résistance des matériaux.

Paris (6e). Gauthier-Villars & Cie, 55, quai des Grands-Augustins. In-8° (23 × 14 cm.), de VIII-120 pages, avec 48 figures et 4 planches. (Prix : 30 francs.)

1929 385 .587

SALMONT (André), directeur de l'Office d'Hygiène industrielle et de Médecine sociale.

Les services de médecine et d'hygiène industrielles et l'organisation scientifique du travail.

Paris (6e). Comité national de l'organisation française, 44, rue de Rennes. Une brochure (21.5 × 13.5). (Prix : 5 francs.)

1929 721 .9

THIBAULT (A.), ingénieur I. N. A.

Calculs simplifiés de stabilité des constructions en béton armé.

Paris (6e). Dunod, 92, rue Bonaparte. 1 volume (16 × 25 cm.), IV-320 pages avec 167 figures. (Prix : 70 francs.)

In German.

1929 625 .1 (.43) & 656 (.43)

BESSER (F.).

Kommentar zur Eisenbahn-Bau- und Betriebsordnung vom 17. Juli 1928 mit vollständigem Text und Anlagen sowie 13 Beilagen.

Berlin. Verlag der Verkehrswissenschaftlichen Lehrmittelgesellschaft m. b. H. bei der deutschen Reichsbahn, 219 Seiten. (Preis : 6.50 Rm. — Vorzugspreis für Reichsbahnangehörige : 5.80 Rm.)

1929 621 .114

EHLERS (C.).

Schmiermittel und ihre richtige Verwendung.

Leipzig. Verlag von Otto Spamer. (Preis : 8 Rm.)

1929 624 .2

KAPFERER (W.).

Tabellen der Maximalquerkräfte und Maximalmomente durchlaufender Träger.

Berlin. Wilhelm Ernst und Sohn. (Preis : 6 Rm.)

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway Science », by M. WEISSENBRUCH in the number for November, 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

1929 621 .132.8

LOMONOSSOFF (G.).

Diesellocomotiven.

Brüssel. Falk, fils, rue des Paroissiens. 401 Abb. & 3 Taf. (Preis : 32 Rm.)

1929 385. (09 (.436)

MAYER (O.).

Entwicklung und Neuordnung der Österreichischen Bundesbahnen.

Iena. Gustav Fischer. Neue Folge der Münchner volkswirtschaftlichen Studien. 118 S. (Preis : 6 Rm.)

1929 313 .385 (.43)

Statistische Nachrichten von den Eisenbahnen des Vereins deutscher Eisenbahnverwaltungen.

Hrsg. von d. geschäftsführ. Verwaltg. d. Vereins. Rechnungsj. 1926. 60 S. (Preis : 8.50 Rm.)

1929 62. (01

TEN BOSCH (M.), Professor an der Eidgenössischen Technischen Hochschule, Zürich.

Vorlesungen über Maschinenelemente.

Berlin. J. Springer. (Preis : Heft I, 6 Rm. — Heft III, 6.60 Rm.)

1929 669 .1

VON KERPELY (K.).

Die metallurgischen und metallographischen Grundlagen des Gusseisens.

Halle a/S. W. Knapp. 120 S. mit 135 Abb. und 34 Zahlentafeln. (Preis : 7.50 Rm.)

In English.

1929 656 .253 (.73)

AMERICAN RAILWAY ASSOCIATION. Committee on automatic train control.

Automatic train control bulletins Nos. 2 and 3. No. 2 describes and illustrates the intermittent inductive train stop of the General Railway Signal Co. No. 3 describes and illustrates the intermittent inductive train stop of the Union Switch and Signal Co.

Washington, D. C. Published by the Association. 109 and 61 pages respectively. (Price : No. 2, 70 cents; No. 3, 50 cents.)

1929 656 .25 (06 (08 (.73)

AMERICAN RAILWAY ASSOCIATION. Signal Section Proceedings.

Minutes of the annual meeting, Stevens Hotel, Chicago, Ill., March 4 and 5, 1929.

New York. Published by the Signal Section, A. R. A., 30, Vesey Street, 145 pages.

1929 347 .763

BAUMERT (Watson A.).

Comparison of American legislation and the International Convention for the unification of certain rules relating to bills of lading.

Washington, D. C. Published by U. S. Government Printing Office. 54 pages. (Price : 10 cents.)

1929 62. (0

DRAFFIN (Jasper Owen).

Strength of materials.

New York. John Wiley & Sons. (6 × 9 inches) 275 pages, illust., portraits, diagrams, tables. (Price $ 3.00.)

1929 721

GODFREY (Edward), Professional Building, Pittsburgh Pa.

Underpinning science : An engineer's ideas on wh[...] actuates the universe.

Pittsburgh, Pa. Published by the author. (6 × inches), 76 pages, illust. (Price : $ 1.)

1928 385 .1 & 656 .2

NICOLLS (R. N.), O. B. E., officer-in-charge, traff[...] surveys.

Memorandum on traffic surveys.

Calcutta. Government of India Central Publicatio[...] Branch. Technical paper No. 264. 37 pages. (Price 6 annas or 8 d.)

1929 385 (.73

Organization of railways. Some material publishe[...] from 1920-1929.

Washington, D. C. Library, Bureau of Railway eco[...] nomics.

1929 62. (0

POORMAN (Alfred P.).

Strength of materials.

New York. McGraw-Hill Book Co. 2nd editio[...] (6 × 9 inches), 343 pages, diagrams, tables. (Price $ 3.00.)

1929 625 .14 (06 (08 (.73

Proceedings of the forty-sixth annual convention [...] the Roadmasters and Maintenance of Way Associatio[...] of America.

Pittsburgh, Pa. Published by the Association, T. [...] Donahoe, Secretary, 428 Mansion Street. (6 1/2 × [...] inches), 198 pages.

1929 62. (0

SCOTT (John Hubert).

Engineering English.

New York. John Wiley and Sons. London. Chapma[...] and Hall, Limited. (Price : 13 sh. 6 d. net.)

1929 624. (0

WADDELL (J. A. L.), consulting engineer.

Memoirs and addresses of two decades.

Easton, Pa. Mack Printing Company. 1 174 page[...] (Price : $ 5.)

In Spanish.

1929 385. (0

FERNANDEZ (M. P.).

Etica y Economica ferroviarias.

Madrid. Imprenta de los Hijos de M. G. Hernande[...] Libertad, 16, duplicado bajo. 245 paginas.

In Italian.

1928 — 313 : 656 .2

BIRAGHI (Pietro), Ing.

L'informazione statistica nei trasporti. Necessità e metodo dei rilievi.

Città di Castello. Tipografia dell' Unione Arti Grafiche. 22 pagine.

1928 — 621 .33 & 623

STABARIN (Alberto), ten. Col. ing.

Considerazioni militari sull'elettrificazione delle ferrovie.

Roma. Tipografia Regionale. 15 pagine.

1929 — 655

STABARIN (Alberto), ten colonnello del genio.

La Federazione internazionale della stampa tecnica e il suo IV° Congresso.

Roma. Arti Grafiche Ugo Pinnaro, Via degli Scipioni. 126. 17 pagine.

[016 .385. (05]

II. — PERIODICALS.

In French.

Arts et Métiers. (Paris.)

1929 — 621 .116

Arts et Métiers, avril, p. 131.

LACASSE (J.). — **Equipement des chaudières au charbon pulvérisé.** (5 800 mots & fig.)

1929 — 621 .392

Arts et Métiers, avril, p. 140.

LEBRUN (M.). — Applications de la **soudure électrique à l'arc.** (5 700 mots & fig.)

Annales des Ponts et Chaussées. (Paris.)

1929 — 624 .5 (01 (.64)

Annales des ponts et chaussées, fasc. I, janv.-fév., p. 5.

COUPRIE. — Epreuves des **ponts suspendus** des Oueds Ykem et Cherrat. (5 400 mots & fig.)

1929 — 62. (01 & 721 .9

Annales des ponts et chaussées, fasc. I, janv.-fév., p. 81.

CHARY. — Note sur le calcul de la **tension de cisaillement du béton dans une pièce fléchie.** (1 000 mots & fig.)

Annales des travaux publics de Belgique (Bruxelles.)

1929 — 624 .2

Annales des trav. publics de Belgique, n° 2, avril, p. 179.

VANDERHEYDEN (F.). — Note sur la théorie des **pièces chargées debout.** (6 200 mots & fig.)

1929 — 624 .2

Annales des trav. publics de Belgique, n° 2, avril, p. 223.

DE CUYPER. — **Action dynamique** des charges en **mouvement sur les ponts métalliques.** (4 500 mots & fig.) (A suivre.)

Bulletin de la Société des ingénieurs civils de France. (Paris.)

1928 — 385 .587

Bull. de la S. des ing. civ. de France, nov.-déc., p. 1197.

CHARPY (G.). — Sur l'**organisation du travail** par commandement continu. (10 200 mots & fig.)

1928 — 669

Bull. de la S. des ing. civ. de France, nov.-déc., p. 1273.

GALIBOURG (J.). — Introduction à l'étude des **propriétés mécaniques des métaux** en fonction de la température. (8 500 mots.)

Bulletin technique de la Suisse romande. (Vevey.)

1929 — 621 .86 (.494)

Bull. techn. de la Suisse Romande, 20 avril, n° 8, p. 86.

DOMMER (A.). — **Pont roulant** de la fabrique de cellulose à Attisholz (Soleure). (1 400 mots & fig.)

Bulletin des transports internationaux par chemins de fer. (Berne.)

1929 — 313 .385 (.481)

Bull. des transp. internat. par ch. de fer, avril, p. 211.

Statistique des chemins de fer norvégiens pour les exercices 1925-26 et 1926-27. (Tableau.)

Bulletin de l'Union internationale des chemins de fer. (Paris.)

1929 — 385 .113 (.493)

Bull de l'Union internat. des ch. de fer, mars, p. 69.

Le **premier exercice d'exploitation** de la Société Nationale des Chemins de fer belges. (1er septembre 1926-31 décembre 1927). (6 000 mots.)

1929 — 385 .113 (.47)

Bull. de l'Union internat. des ch. de fer, mars, p. 78.

Les Chemins de fer de l'Etat letton pendant la première période décadaire (1918-1928) de leur fonctionnement. (700 mots & 1 tableau.)

*

1929 385 .113 (.43)
Bull. de l'Union internat. des ch. de fer, mars, p. 85.
Rapport du Commissaire des Chemins de fer allemands à la Commission des Réparations sur la quatrième année d'application du plan des Experts. — 1er septembre 1927-31 août 1928 (11 600 mots) (suite et fin).

Chronique des transports. (Paris.)

1929 385 .113 (.44)
Chronique des transport, n° 7, 10 avril, p. 2.
L'exploitation du réseau d'Orléans en 1928. (4 200 mots.)

Génie civil. (Paris.)

1929 621
Génie civil, n° 2434, 6 avril, p. 333.
Construction des machines. — La mesure des filetages des vis à filet triangulaire. (2 450 mots & fig.)

1929 669 .1
Génie civil, n° 2434, 6 avril, p. 336.
La trempe des aciers au four électro-magnétique Wild-Barfield. (1 550 mots & fig.)

1929 625 .4 (.42) & 656 .211 (.42)
Génie civil, n° 2435, 13 avril, p. 357.
CAUFOURIER (P.). — La nouvelle station de Piccadilly Circus (Réseau métropolitain de Londres). (3 000 mots.)

1929 624 .2
Génie civil, n° 2436, 20 avril, p. 378.
MOLITOR (P.). — Influences de la variation des sections et des déformations par efforts tranchants dans le calcul des poutres droites continues. (3 300 mots & fig.)

1929 62. (01
Génie civil, n° 2436, 20 avril, p. 381.
BREUIL (P.). — Nouvelle presse universelle, système Amsler, pour les essais des matériaux de construction. (1 900 mots & fig.)

1929 656 .1 (.494) & 656 .2 (.494)
Génie civil, n° 2436, 20 avril, p. 388.
La concurrence entre l'automobile et le chemin de fer en Suisse. (800 mots.)

1929 621 .94 (.42)
Génie civil, n° 2437, 27 avril, p. 397.
Construction des machines. Tour à grande vitesse, de 1m. 06 de hauteur de pointes. (2 000 mots & fig.)

1929 624 .63 (.73)
Génie civil, n° 2437, 27 avril, p. 409.
Pont-route en béton armé, construit à l'aide d'éléments préparés, sur la baie de San Francisco (Etats-Unis). (1 100 mots & fig.)

1929 669 .1 (.43)
Génie civil, n° 2437, 27 avril, p. 412.
Les nouveaux aciers de construction en Allemagne. (800 mots.)

1929 621 .331 (.492)
Génie civil, n° 2437, 27 avril, p. 413.
Sous-stations automatiques, à redresseurs de courant, des Chemins de fer néerlandais. (800 mots et fig.)

1929 621 .116
Génie civil, n° 2438, 4 mai, p. 429.
Le chauffage au charbon pulvérisé des chaudières à foyer intérieur. (1 400 mots & fig.)

La Science et la Vie. (Paris.)

1929 625 .4 (.42) & 656 .211 (.42)
La Science et la Vie, mai, n° 143, p. 416.
MAUREL (J.). — Une station vraiment moderne pour un métro. (2 200 mots & fig.)

Les chemins de fer et les tramways. (Paris.)

1929 621 .132.8 (.54)
Les chemins de fer et les tramways, avril, p. 68.
Locomotives à vapeur à voie de 0 m. 760 pour l'Inde anglaise. (3 000 mots & fig.)

1929 625 .4 (.73)
Les chemins de fer et les tramways, avril, p. 72.
Le nouveau chemin de fer souterrain de Philadelphie ou « Subway de Broad Street ». (5 000 mots & fig.)

1929 621 .132.3 (.44)
Les chemins de fer et les tramways, avril, p. 78.
Les modifications apportées à la 41.001 de la Compagnie de l'Est. (300 mots.)

1929 621 .133.5
Les chemins de fer et les tramways, avril, p. 79.
Régulateur de tirage pour locomotives. (800 mots.)

1929 625 .211
Les chemins de fer et les tramways, avril, p. 80.
Châssis monobloc pour matériel roulant. (800 mots & fig.)

1929 625 .144.1
Les chemins de fer et les tramways, avril, p. 81.
Dispositif de ballastage mobile. (1 200 mots.)

1929 625 .171
Les chemins de fer et les tramways, avril, p. 82.
Procédé et dispositif pour la surveillance de l'état des voies ferrées. (1 800 mots & fig.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

1929 621 .133.1
L'Ind. des voies fer. et des transp. autom., avril, p. 143.
RESAL. — La chauffe au charbon pulvérisé des chaudières à vapeur. (3 000 mots & fig.)

1929 625 .212
L'Ind. des voies fer. et des transp. autom., avril, p. 147 et mai, p. 185.
CASTAING. — Liaison des essieux avec le châssis. Etude des essieux fixes. (15 000 mots & fig.)

1929 625 .62 (.44)
L'Ind. des voies fer. et des transp. autom., mai, p. 175.
KERAVAL. — L'exploitation par motrices à un seul agent à la Société des transports en commun de la région parisienne. (2 800 mots & fig.)

Revue universelle des transports et des communications. (Paris.)

1929
Rev. univ. des transp. et des com., n° 100 C, p. 121.
RENY (P. E.). — Avertisseur-enregistreur de la position des signaux avancés avec dispositif pour l'arrêt automatique de tous les trains, système Reny (2 200 mots & fig.) (à suivre).

1929 625 .143.3
Rev. univ. des transp. et des com., n° 100 C, p. 124.
L'usure ondulatoire des rails dans les tramways et les chemins de fer. (2 300 mots.)

Revue Universelle des Mines. (Liége.)

1929 624. (06
Revue universelle des mines, n° 8, 15 avril, p. 221.
BEAUJEAN (C.). — Deuxième Congrès international de construction des ponts et charpentes en fer et en béton armé. (2 400 mots.)

1929 624 .63
Revue universelle des mines, n° 8, 15 avril, p. 224.
EMPERGER (F.). — Les barres d'armature des arcs en béton armé. (2 000 mots & fig.)

1929 621 .392 & 624 .92
Revue universelle des mines, n° 8, 15 avril, p. 227.
DUSTIN (H.). — Note sur les charpentes soudées. Calcul des assemblages. (7 000 mots & fig.)

1929 62. (01
Revue universelle des mines, n° 8, 15 avril, p. 237.
VAN DER HAEGHEN (J. F.). — Résumé de la théorie vibratoire du flambage des pièces chargées debout. (2 400 mots & fig.)

1929 624 .6 (.493)
Revue universelle des mines, n° 8, 15 avril, p. 240.
BAES (L.). — Un vérin à sable de 700 tonnes pour décintrement de ponts en arcs. (2 700 mots & fig.)

1929 624. (01
Revue universelle des mines, n° 8, 15 avril, p. 246.
RONSSE (A.). — Actions dynamiques des charges en mouvement sur les ponts métalliques. (1 500 mots.)

1929 624. (01
Revue universelle des mines, n° 8, 15 avril, p. 247.
CAMPUS (F.). — Calcul des barres relevées et des étriers des pièces fléchies en béton armé. (1 900 mots & fig.)

1929 624 .614 & 624 .63
Revue universelle des mines, n° 8, 15 avril, p. 250.
CAMPUS (F.). — Ponts en béton ou en maçonnerie à anneaux multiples. (2 500 mots & fig.)

Revue générale des chemins de fer. (Paris.)

1929 625 .232 (.44)
Revue générale des chemins de fer, mai, p. 343.
TÊTE. — Améliorations apportées par la Compagnie P.-L.-M. à ses voitures à bogies des grands trains. (3 200 mots & fig.)

1929 625 .212 (.44)
Revue générale des chemins de fer, mai, p. 353.
DEVAUD (G.). — Appareil graisseur de rails de la Compagnie d'Orléans. (2 600 mots & fig.)

1929 385 .113 (.494)
Revue générale des chemins de fer, mai, p. 357.
Résultats d'exploitation des Chemins de fer Fédéraux suisses pour 1927 et prévisions budgétaires pour 1929. (6 000 mots.)

Revue politique et parlementaire. (Paris.)

1929 385 .588
Revue politique et parlementaire, 10 avril, p. 18.
COLSON (C.). — Le rôle des syndicats dans les conventions et les conflits collectifs du travail (5 300 mots.)

1929 385 .21
Revue politique et parlementaire, 10 avril, p. 117.
BLOCH (R.). — Les chemins de fer et la navigation intérieure. (2 600 mots.)

1929 385 (.42)
Revue politique et parlementaire, 10 mai, p. 200.
PESCHAUD (M.). — L'aspect économique des transports par chemins de fer en Grande-Bretagne. (13 000 mots.)

1929 385 (.44)
Revue politique et parlementaire, 10 mai, p. 322.
COLSON (C.). — Les grands réseaux de chemins de fer de 1913 à 1928. (7 600 mots & 1 tableau.)

In German.

Archiv für Eisenbahnwesen. (Berlin.)

1928 385 .581 (.43)
Archiv für Eisenbahnwesen, Heft 4, Juli-Aug., S. 58.
ROHLING (K.). — Die Arbeitszeit im Lohntarifvertrag der deutschen Reichsbahngesellschaft. (14 000 Wörter & 3 Tafeln.)

1928 385 .113 (.497 .2)
Archiv für Eisenbahnwesen, Heft 4, Juli-Aug., S. 989.
Die **bulgarischen Staatseisenbahnen** im Rechnungsjahr 1925-26. (Tafeln.)

1928 385 .113 (.44)
Archiv für Eisenbahnwesen, Heft 4, Juli-Aug., S. 1014.
Die **Betriebsergebnisse** der fünf grossen französischen Eisenbahngesellschaften im Jahr 1926. (Tafeln.)

1929 313 .385 (.3)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 1.
Die **Eisenbahnen der Erde** im Jahr 1926. (500 Wörter & Tafeln.)

1929 385. (09.3 (.51)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 12.
WUISIN (S.). — Die Entwicklung des **Eisenbahnwesens** in China. (14 500 Wörter & Tafel.)

1929 385. (09 (.493)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 51.
VON RENESSE. — Die **nationale Gesellschaft** der belgischen Eisenbahnen. (12 500 Wörter & 2 Tafeln.) (Fortsetzung folgt.)

1929 313 .385 (.497 .1)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 81.
REMY. — Die **südslawischen Eisenbahnen** 1922 bis 1924. (4 000 Wörter, 26 Tafeln und 2 Karten.)

1929 385. (01 (.6)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 102.
GENEST. — Gründung einer Studiengemeinschaft für die **Transsahara-Eisenbahn**. (1 850 Wörter.)

1929 625 .6 (.438)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 107.
CREMER (M.). — Die **Schmalspurbahnen** Polens. (3 200 Wörter & Tafeln.)

1929 385 .113 (.43)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 121.
Die **Eisenbahnen** des Deutschen Reichs 1926. (200 Wörter & Tafeln.)

1929 385 .113 (.439)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 147.
RAJZ (K.). — Die **Königlich ungarischen Staatsbahnen** im Betriebsjahr 1925-26. (450 Wörter & Tafeln.)

1929 385 .113 (.492)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 157.
OVERMANN. — Die **niederländischen Eisenbahnen** in Jahr 1927. (3 200 Wörter & Tafeln.)

1929 313 .385 (.73)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 168.
Die **Eisenbahnen** der Vereinigten Staaten von Amerika in den Jahren 1925 und 1926. (4 200 Wörter, Tafeln & 1 Karte.)

1929 385 .113 (.593)
Archiv für Eisenbahnwesen, Heft 1, Jan.-Feb., S. 197.
Die Kgl. **Siamesischen Staatsbahnen** in der Zeit vom 1. April 1926 bis zum 31. März 1927. (400 Wörter & Tafeln.)

Glasers Annalen. (Berlin.)

1929 625 .235
Glasers Annalen, Heft 6, 15. März., S. 93.
Türschliessvorrichtungen bei modernen Verkehrsmitteln. (1 650 Wörter & Abb.)

1929 625 .251
Glasers Annalen, Heft 7, 1. April, S. 99.
THOMA (H.). — **Die Kurzschlussbremse** im Strassenbahnbetrieb. (7 500 Wörter & Abb.)

1929 621 .334 (.43)
Glasers Annalen, Heft 7, 1. April, S. 109.
WINCKLER (R.). — Herstellung und Verwendung **elektrischer Akkumulatoren** unter besonderer Berücksichtigung elektrischer Fahrzeuge. (1 500 Wöter & Abb.)

Elektrotechnische Zeitschrift. (Berlin.)

1929 625 .4 (.433)
Elektrotechnische Zeitschrift, Heft 14, 4. April, S. 489.
Bahnen und Fahrzeuge. (Tafeln.)

1929 621 .33
Elektrotechnische Zeitschrift, Heft 16, 18. April, S. 561.
VOIGTLANDER (H.). — **Fahrzeit, Wattstundenverbrauch und Effektivstrom** im Bahnbetrieb. (4 900 Wörter & Abb.)

1929 621 .33 (.494)
Electrotechnische Zeitschrift, Heft 17, 25. April, S. 599.
Zum Abschluss der **beschleunigten Elektrisierung** der Schweizerischen Bundesbahnen. (3 100 Wörter, Abb. & 2 Tafeln.) (Schluss folgt.)

In English.

Electric Railway Journal. (New-York.)

1929 621 .338 (.73)
Electric Railway Journal, No. 13, April, p. 503.
HECKER (G. C.). — Save $ 2 000 000 in **equipment maintenance**. (2 000 words & fig.)

1929 625 .144 (.73)
Electric Railway Journal, No. 13, April, p. 509.
GEORGE (H. H.). — Careful organization essential **for rapid track reconstruction**. (2 400 words & fig.)

1929 621 .338 (.73)
Electric Railway Journal, No. 13, April, p. 513.
WILLIAMS (H. S.). — **Reducing noise of car operation**. (2 000 words & fig.)

1929 725 .33 (.73)
Electric Railway Journal, No. 13, April, p. 520.
Bus maintenance well standardized. (2 000 words & fig.)

1929 625 .214
Electric Railway Journal, No. 13, April, p. 535.
HILLMAN (E. H.). — Light oils for car bearings have possibilities. (3 000 words & fig.)

1929 621 .336 (.73)
Electric Railway Journal, No. 13, April, p. 539.
BIRCH (L. W.). — Attention to fundamentals reduces overhead maintenance. (2 600 words.)

1929 656 .211.4 (.73) & 725 .31 (.73)
Electric Railway Journal, No. 14, May, p. 576.
FAUST (C. A.). — Cleveland terminal project nearing completion. (4 100 words & fig.)

1929 625 .214 (.73)
Electric Railway Journal, No. 14, May, p. 601.
New Timken truck equipped with armature shaft brake. (1 000 words & fig.)

Engineer. (London.)

1929 621 .132.8
Engineer, No. 3822, April 12, p. 398.
Development of the Ljungström locomotive. II. The second Ljungström locomotive (2 400 words & fig.) (to be continued).

1929 624 .51 (.73)
Engineer, No. 3822, April 12, p. 400.
Broken wires in suspension bridge cables. (2 000 words.)

1929 624 .51 (.73)
Engineer, No. 3822, April 12, p. 403.
The Ambassador bridge over the Detroit River. (2 500 words & fig.)

1929 625 .143.3 (.42)
Engineer, No. 3822, April 12, p. 413.
Steel sleepers. — The G. K. N. (Guest, Keen & Nettlefolds) type. (1 200 words & fig.)

1929 621 .132.8
Engineer, No. 3823, April 19, p. 424.
Development of the Ljungström locomotive. III. The third Ljungström locomotive. (3 800 words & fig.) (Conclusion.)

1929 385. (09.1 (.71)
Engineer, No. 3823, April 19, p. 427.
The Churchill Harbour terminus of the Hudson Bay Railway. (1 900 words & fig.)

1929 656 .253 (.42) & 656 .283 (.42)
Engineer, No. 3823, April 19, p. 438.
Railway operation in fog. (1 500 words.)

1929 621 .331 (.86)
Engineer, No. 3823, April 19, p. 440.
The Alouette hydro-electric generating station. (4 100 words & fig.)

1929 385 .13 (.42) & 656 .233 (.42)
Engineer, No. 3824, April 26, p. 463.
Railway reform. (1 800 words.)

Engineering. (London.)

1929 721 .1 (.73)
Engineering, No. 3300, April 12, p. 447.
SKINNER (F. W.). — Foundation plan for « Evening Post » building. (2 500 words & fig.)

1929 536
Engineering, No. 3300, April 12, p. 466.
NÄGEL (A.). — The transfer of heat in reciprocating engines. IV. (4 200 words & fig.)

1929 621 .392 & 621 .9
Engineering, No. 3300, April 12, p. 471.
Electric welding plant. (700 words & fig.)

1929 625 .13 (.44) & 656 .222.1 (.44)
Engineering, No. 3300, April 12, p. 481 and No. 3302, April 26, p. 524.
MONKSWELL (Lord). — French railway locomotive performance. (7 700 words & fig.)

Engineering News-Record. (New-York.)

1929 621 .9
Engineering News-Record, No. 14, April 4, p. 528.
VIVIAN (C. H.). — Motorizing the hand tool. (2 700 words & fig.)

1929 621 .43
Engineering News-Record, No. 14, April 4, p. 532.
MORRISON (L. H.). — Economics of Diesel-powered construction equipment. (2 700 words & fig.)

1929 625 .122
Engineering News-Record, No. 14, April 4, p. 556.
MILLER (J. G.). — Power shovels show revolutionary advance. (3 700 words & fig.)

1929 691
Engineering News-Record, No. 15, April 11, p. 580.
McMILLAN (F. R.). — Basic principles of concrete-making. — I. Cement paste the basis of concrete quality. (3 300 words & fig.)

1929 624 .51 (.73)
Engineering News-Record, No. 15, April 11, p. 591.
Long belts transport aggregates and concrete for Hudson River bridge anchorage. (2 500 words & fig.)

1929 624 .51 (.73)
Engineering News-Record, No. 15, April 11, p. 602.
Technical aspects of cable wire breakages on the Mount Hope suspension bridge. (3 600 words & fig.)

1929 621 .392 (.73)
Engineering News-Record, No. 16, April 18, p. 618.
Welding a four-story commercial building. (2 000 words & fig.)

1929 691
Engineering News-Record, No. 16, April 18, p. 625.
McMILLAN (F. R.). — **Basic principles of concrete-making.** — II. Strength and watertightness supporting data. (5 500 words & fig.)

1929 624 .2
Engineering News-Record, No. 17, April 25, p. 667.
MOLITOR (D. A.). — **Stress analysis of long-span three-hinge roof trusses.** (1 200 words & fig.)

1929 691
Engineering News-Record, No. 17, April 25, p. 673.
McMILLAN (F. R.). — **Basic principles of concrete-making.** — III. Combining aggregates with paste to make workable concrete. (7 200 words, tables & fig.)

1929 691
Engineering News-Record, No. 18, May 2, p. 705.
McMILLAN (F. R.). — **Basic principles of concrete-making.** — IV. Application to specific conditions. (5 200 words, fig. & tables.)

1929 625 .13 (.73) & 656 .259 (.73)
Engineering News-Record, No. 18, May 2, p. 710.
Methods of **controlling traffic** in the Oakland estuary tube. (1 500 words & fig.)

1929 621 .392 (.71) & 625 .17 (.71)
Engineering News-Record, No. 18, May 2, p. 719.
Welding worn rail ends in track, Canadian Pacific Railways. (1 700 words.)

Institution of Engineers, Australia. (Sydney.)

1929 621 .392 (.94)
Institution of Engineers, Austr., No. 2, Feb., p. 57.
CHAPMAN (W. D.). — **Strengthening of Echuca bridge by electric welding.** (3 600 words.)

Journal of the Institute of Transport. (London.)

1929 385 .4
Journal of the Institute of Transport, April, p. 297.
PICK (F.). — The administration of **transport undertakings-organization.** (9 300 words.)

1929 625 .62
Journal of the Institute of Transport, April, p. 314.
JACKSON (A. A.). — The sphere of the **railless trolley vehicle** system. (5 300 words.)

Locomotive Railway Carriage & Wagon Review. (London.)

1929 621 .132.7 (.42)
Loc. Ry. Carriage & Wagon Review, April 15, p. 103.
Locomotives for shunting, Southern Ry. (600 words & fig.)

1929 625 .616 (.54
Loc. Ry. Carriage & Wagon Review, April 15, p. 10
4-6-4 passenger locomotives, 2 ft. 6 in. gauge, Bars Light Railway, India. (600 words & fig.)

1929 625 .616 (.62
Loc. Ry. Carriage & Wagon Review, April 15, p. 10
3 ft. 6 in. gauge locomotive, Egyptian State Rys. (50 words & fig.)

1929 621 .132.3 (.492
Loc. Ry. Carriage & Wagon Review, April 15, p. 10
Four-cylinder express engines, Netherlands Rys. (80 words & fig.)

1929 625 .254 (.42
Loc. Ry. Carriage & Wagon Review, April 15, p. 11
Wood's patent **vacuum breaking device** for locomo tives. (600 words & fig.)

1929 625 .23
Loc. Ry. Carriage & Wagon Review, April 15, p. 12
Aluminium for railway **rolling stock.** (1 000 words fig.)

London & North Eastern Railway Magazine. (London.)

1929 625 .232 (.42
L. & N. E. Railway Magazine, May, p. 251.
PEPPERCORN (A. H.). — **Travelling Post Offic vans.** (900 words & fig.)

Modern Transport. (London.)

1929 385 .113 (.493
Modern Transport, No. 526, April 13, p. 4.
Transport in Belgium. A year of notable progres (2 600 words.)

1929 385. (09 (.71
Modern Transport, No. 526, April 13, p. 6.
The **Hudson Bay route to Europe.** (1 900 words fig.)

1929 621 .138.5 (.42
Modern Transport, No. 526, April 13, p. 11.
Locomotive repair costs. Comparative examination statistical returns. (1 000 words.)

1929 656 .1 (.494) & 656 .2 (.49
Modern Transport, No. 527, April 20, p. 4.
Co-ordination between rail and road. (2 400 words.

1929 621 .33 (.42
Modern Transport, No. 527, April 20, p. 6.
Electrification of the Mumbles Railway. (2 100 word & fig.)

1929 656 .256.
Modern Transport, No. 527, April 20, p. 9.
Safeguards in **railway signalling.** (2 000 words fig.)

1929 621 .33 (.82)
Modern Transport, No. 527, April 20, p. 10.
Railway electrification in Argentina. (1 200 words & fig.)

1929 656 .283 (.42)
Modern Transport, No. 527, April 20, p. 13.
Inspecting officer's report on Ashchurch accident. (1 100 words & fig.)

1929 625 .253 (.42) & 625 .255 (.42)
Modern Transport, No. 528, April 27, p. 3.
Improved braking on the District Railway. (1 600 words & fig.)

1929 656 .211 (.44) & 721 .31 (.44)
Modern Transport, No. 528, April 27, p. 6.
The new right bank station at Rouen. (1 900 words & fig.)

1929 656 .1 (.931) & 656 .2 (.931)
Modern Transport, No. 528, April 27, p. 9.
Railway road transport in New Zealand. (1 500 words & fig.)

Mechanical Engineering. (New-York.)

1929 656 .223.2 (.73)
Mechanical Engineering, May, p. 382.
Heavier loading of freight cars. (1 100 words.)

Proceedings, American Society of Civil Engineers. (New-York.)

1929 62. (01
Proceed. American Soc. Civ. Eng., April, p. 855.
TIMOSHENKO (S.). — Problems concerning elastic stability in structures. (5 300 words & fig.)

1929 721 .1
Proceed. American Soc. Civ. Eng., April, p. 949.
TERZAGHI (Ch.). — The science of foundations — its present and future. (14 000 words & fig.)

Proceedings, Institution of Civil Engineers. (London.)

1928 621 .9
Proceed., Inst. of Mechan. Eng., No. 4, December, p. 775.
HERBERT (E. G.). — Cutting tools research committee. Report on machinability. (22 000 words, 5 tables & fig.)

1928 62. (01 & 669
Proceed., Inst. of Mechan. Eng., No. 4, December, p. 827.
OLIVER (D. A.). — Proposed new criteria of ductility from a new law connecting the percentage elongation with size of test-piece. (13 000 words, 9 tables & fig.)

1928 62. (01 & 669
Proceed., Inst. of Mechan. Eng., No. 4, December, p. 865.
LEA (F. C.) & BATEY (R. A.). — The properties of cold-drawn wires, with particular reference to repeated torsional stresses. (8 000 words, 4 tables & fig.)

1928 621 .133.2
Proceed., Inst. of Mechan. Eng., No. 4, December, p. 985.
HERBERT (T. M.). Locomotive firebox conditions: gas compositions and temperatures close to copper plates. (6 000 words, 12 tables & fig.)

Railway Age. (New-York.)

1929 621 .132.8 & 621 .4
Railway Age, No. 13, March 30, p. 724.
WANAMAKER (E.). — Rail motor car problems discussed. (6 600 words & fig.)

1929 691 (.73)
Railway Age, No. 13, March 30, p. 731.
BLAESS (A. F.). — What one road has secured from treated timber. (2 400 words.)

1929 656 .254 (.73) & 656 .256.3 (.73)
Railway Age, No. 13, March 30, p. 733.
Manual block signals controlled remotely on the Big Four. (1 200 words & fig.)

1929 656 .1 & 656 .2
Railway Age, No. 13, March 30, p. 740.
BUDD (R.). — Railways and highways. How the development of motor transportation has affected the railways. (2 000 words.)

1929 625 .18 (.73)
Railway Age, No. 13, March 30, p. 742.
Burlington puts waste lumber back to work. (1 700 words, fig. & 1 table.)

1929 725 .33
Railway Age, No. 14, April 6, p. 773.
Canadian National builds modern terminal facilities. (5 400 words & fig.)

1929 656 .255 (.73)
Railway Age, No. 14, April 6, p. 783.
SMITH (B. L.). — Automatic gauntlet signals installed on the South Shore. (1 500 words & fig.)

1929 621 .335 (.73) & 621 .4 (.43)
Railway Age, No. 14, April 6, p. 787.
HERSHBERGER (D. G.). — Westinghouse builds 300-hp. oil locomotive. (2 900 words & fig.)

1929 656 .225 (.73)
Railway Age, No. 14, April 6, p. 793.
Containers as an operating problem. (2 000 words.)

1929 621 .133.7 (.73)
Railway Age, No. 15, April 13, p. 828.
Chicago & Alton checks corrosion in locomotive boilers. (3 600 words & fig.)

1929 656 .1 (.73) & 656 .225 (.73)
Railway Age, No. 15, April 13, p. 833.
Container and L. C. L. operating costs compared (4 500 words & fig.)

1929 621 .33 (.73)
Railway Age, No. 15, April 13, p. 839.
KERR (D. J.). — **Great Northern electric locomotive operation.** (1 900 words & fig.)

1929 625 .26 (.73)
Railway Age, No. 15, April 13, p. 844.
WILCOX (E. M.). — Reducing transfers to the **vanishing point.** (1 600 words & fig.)

1929 656 .258 (.73)
Railway Age, No. 16, April 20, p. 894.
Michigan Central installs **simplified electric interlocker.** (1 300 words & fig.)

1929 625 .1 (.73)
Railway Age, No. 16, April 20, p. 897.
Rock Island builds line in Texas. (3 100 words & fig.)

1929 625 .232 (.73)
Railway Age, No. 16, April 20, p. 907.
Lounge cars for the Rock Island. (1 400 words & fig.)

1929 621 .13
Railway Age, No. 16, April 20, p. 909.
WOODARD (W. E.). — **Modern locomotives** for **secondary service.** (2 700 words, 4 tables & fig.)

1929 621 .133.1 & 656 .222.1
Railway Age, No. 17, Section one, April 27, p. 954.
STUEBING (A. F.). — **Locomotive performance** and **operating costs.** (2 900 words, 4 tables & fig.)

1929 625 .13 (.73)
Railway Age, No. 17, Section one, April 27, p. 959.
Float 300-ft. span into place in a swift current. (1 700 words & fig.)

1929 656 .1 (.73) & 656 .261 (.73)
Railway Age, No. 17, Section two, April 27, p. 999.
MEREDITH (J. W.). — One **motor truck** saves $ 28 000 for Jersey Central. (2 100 words & fig.)

1929 656 .1 (.73)
Railway Age, No. 17, Section two, April 27, p. 1001.
Railroads report on their **motor transport activities** (1 900 words & tables.)

1929 656 .1 (.73)
Railway Age, No. 17, Section two, April 27, p. 1003.
Cotton Belt replaces trains with **motor vehicles.** (2 400 words, 1 table & fig.)

1929 656 .261 (.73)
Railway Age, No. 17, Section two, April 27, p. 1008.
L. C. L. transfer by **motor truck.** (2 500 words & fig.)

1929 656 .1 (.73
Railway Age, No. 17, Section two, April 27, p. 1013.
Off-rail stations increase business. (2 900 words & fig.)

Railway Engineer. (London.)

1929 621 .132.5 (.82
Railway Engineer, No. 592, May, p. 165.
New **heavy freight locomotives** for the Buenos Ayre & Pacific Railway. (1 000 words & fig.)

1929 621 .138.5 (.42
Railway Engineer, No. 592, May, p. 168.
Reorganisation of Crewe locomotive works, L. M. S Ry. Stores department. (3 200 words & fig.)

1929 625 .212 (.42
Railway Engineer, No. 592, May, p. 180.
A new **wheel centre** for rolling-stock. (500 words & fig.)

1929 656 .255 (.42
Railway Engineer, No. 592, May, p. 181.
Improved methods in the **operation of single tracks** (4 200 words & fig.) (to be continued).

1929 625 .13 (.54
Railway Engineer, No. 592, May, p. 186.
Madras & Southern Mahratta Railway **bridge** re-erec tion. (500 words.)

1929 625 .14 (.54
Railway Engineer, No. 592, May, p. 187.
DAWSON (E.). — A **track recorder** for railway (2 400 words & fig.)

1929 624 .2 (.42
Railway Engineer, No. 592, May, p. 190.
Strainmeter tests of a railway bridge. (400 words

1929 625 .23
Railway Engineer, No. 592, May, p. 191.
COPPOCK (C.). — Some problems of **electric trai lighting.** (7 000 words & fig.)

1929 625 .175 (.42
Railway Engineer, No. 592, May, p. 197.
A handy **rail inspection car.** (500 words & fig.)

1929 621 .94 (.42
Railway Engineer, No. 592, May, p. 198.
A new railway **wheel lathe.** (800 words & fig.)

1929 621 .335 (.494
Railway Engineer, No. 592, May, p. 199.
Electric locomotives, Bernese Oberland Railwa (1 000 words & fig.)

Railway Engineering & Maintenance. (Chicago.)

1929 625 .122 (.73
Railway Engineering and Maintenance, April, p. 154.
Machines save men in **grade revision work.** (2 8(words & fig.)

1929 621 .137 (.73)
Railway Engineering and Maintenance, April, p. 158.
COUGHLAN (R. E.). — Co-operation produces results in water treatment. (2 000 words & fig.)

1929 624 (.73) & 691 (.73)
Railway Engineering and Maintenance, April, p. 162.
VON SCHRENK (H.). — Making good timber last longer in bridges. (4 700 words & fig.)

1929 625 .14 (.73)
Railway Engineering and Maintenance, April, p. 169.
MILLER (A. A.). — Programming section work as a step toward efficiency. (1 600 words & fig.)

1929 621 .87 (.73) & 625 .17 (.73)
Railway Engineering and Maintenance, April, p. 171.
WALKER (Th.). — Getting the most service from a rail crane. (1 600 words & fig.)

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Railway Engineering and Maintenance, April, p. 173.
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Railway Gazette. (London.)

1929 625 .232 (.42)
Railway Gazette, No. 15, April 12, p. 529.
Travelling Post Office vans. (400 words & fig.)

1929 621 .132.8 (.86)
Railway Gazette, No. 15, April 12, p. 530.
New Garratt locomotives for South America. (700 words & fig.)

1929 656 .1 (.42)
Railway Gazette, No. 15, April 12, p. 534.
Great Western Railway road transport developments. (800 words & fig.)

1929 385 .4 (.42)
Railway Gazette, No. 16, April 19, p. 566.
Organization of the superintendents' department. (1 600 words.)

1929 625 .616 (.42)
Railway Gazette, No. 16, April 19, p. 570.
New 2-8-2 type locomotives for the Gwalior Light Railways. (400 words.)

1929 625 .234
Railway Gazette, No. 16, April 19, p. 570.
A simple form of steam trap. (250 words & fig.)

1929 659 (.54)
Railway Gazette, No. 16, April 19, p. 572.
Railway publicity in India (No. II). (1 700 words & fig.)

1929 313 .385 & 657
Railway Gazette, No. 17, April 26, p. 602.
The ton-mile: What of it? (1 900 words.)

1929 627 (.42)
Railway Gazette, No. 17, April 26, p. 604.
Southampton docks extension works. (1 200 words & fig.)

1929 621 .138.2 (.42)
Railway Gazette, No. 17, April 26, p. 606.
An electrically-operated locomotive coaling plant. (500 words & fig.)

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Railway Gazette, No. 18, May 3, p. 632.
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Steel sleepers on the Great Western Railway. (700 words & fig.)

Railway Magazine. (London.)

1929 656 .222.1 (.494)
Railway Magazine, May, p. 337.
PEARSON (J. P.). — Express train running in Switzerland. (2 300 words & fig.)

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Railway Magazine, May, p. 353.
ALLEN (C. J.). — British locomotive practice and performance. (7 600 words & fig.)

Railway Mechanical Engineer. (New-York.)

1929 621 .335 & 621 .4
Railway Mechanical Engineer, April, p. 175.
WANAMAKER (E.). — Rail motor design and maintenance. (5 300 words & fig.)

1929 621 .132.5 (.73)
Railway Mechanical Engineer, April, p. 181.
Examples of recent locomotives of the 2-8-2 type. (Table.)

1929 385. (07.5 (.73)
Railway Mechanical Engineer, April, p. 182.
LYFORD (F. E.). — Suggested library for a railroad apprentice school. (1 600 words & fig.)

1929 625 .175 (.71)
Railway Mechanical Engineer, April, p. 183.
Automotive inspection car for Canadian Pacific. (900 words & fig.)

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EKSERGIAN (R.). — Balancing and dynamic loading of locomotives. Part I. (6 000 words & fig.)

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Automatic gauntlet signals installed on the South Shore. (1 400 words & fig.)

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Railway Signaling, April, p. 147.
Track shunting by rail motor cars. (2 600 words & fig.)

University of Illinois Bulletin. (Urbana.)

1929 697
University of Illinois Bull., No. 189, January 8, p. 1.
WILLARD (A. C.), KRATZ (A. P.) & DAY (V. S.). — Investigation of warm-air furnaces and heating systems. The research residence. Part. IV. (26 000 words, 20 tables & fig.)

1929 62. (01 & 691
University of Illinois Bull., No. 190, April 2, p. 1.
RICHART (F. E.), BRANDTZAEG (A.) & BROWN (R. L.). — The failure of plain and spirally reinforced concrete in compression. (20 000 words, 9 tables & fig.)

In Spanish.

Ingenieria y Construcción. (Madrid.)

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Ingenieria y construcción, n° 75, Marzo, p. 120.
REDER (G.). — Tracción Diesel (3 400 palabras & fig.) (continuarà).

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LEE (C. K.). — Recientes progresos en los tranvias eléctricos americanos. (1 500 palabras & fig.)

Revista de Obras Públicas. (Madrid.)

1929 625 .112 (.460)
Revista de obras públicas, n° 8, 15 de Abril, p. 152.
MACHIMBARRENA (V.). — El ancho de la via de los ferrocarriles españoles (III) (2 000 palabras) (continuarà).

1929 625 .112 (.460)
Revista de obras públicas, n° 9, 1° de Mayo, p. 163.
MACHIMBARRENA (V.). — El ancho de via de los ferrocarriles españoles (IV) (2 900 palabras & fig.) (continuarà).

In Italian.

Annali dei lavori pubblici. (Roma.)

1928 62. (01
Annali dei lavori pubblici, n° 12, dicembre, p. 1085.
BELLUZZI (O.). — Sul modo di tener conto del peso proprio nel calcolo della pressoflessione. (3 900 parole & fig.)

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Annali dei lavori pubblici, n° 12, dicembre, p. 1114.
Applicazione del carbone polverizzato alle locomotive (1 600 parole & fig.)

L'Ingegnere. (Roma.)

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SIROVICH (G.). — La fragilità nel ferro omogeneo (4 550 parole & fig.)

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MANNO (A.). — L'eruzione dell'Etna del novembre 1928 e l'interruzione della linea ferroviaria Catania-Messina. (4 600 parole & fig.)

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Rivista tecnica delle ferrovie ital., 15 marzo, n° 3, p. 88.
GOTELLI (R.). — I nuovi impianti della stazione di Ventimiglia. (1 800 parole, 1 quadro & fig.)

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ABBOLITO (F.). — Qualche raffronto tra i valori della prova di trazione e quelli della prova di resilienza su rotaie e cerchioni omogenei ed eterogenei. (900 parole, 12 quadri & fig.)

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De Ingenieur. (Den Haag.)

1929 621 .392
De Ingenieur, nr 14, 6 April, p. 95.
BURKY (J. F. W.). — Het electrisch lasschen van bruggen en ijzerconstructies. (10 000 woorden & fig.)

1929 691 (.492)
De Ingenieur, nr 16, 20 April, p. 117.
VAN BRUGGEN (J. P.). — Bouwcontrôle bij de betonwerken voor de nieuwe opritten der Willemsbrug te Rotterdam. (3 900 woorden & fig.)

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KIST (N. C.). — Bepaling van de afmetingen van open koppelingen in gedrukte staven. (2 300 woorden & fig.)

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LAMAN TRIP (G. J.). — Iets over de stationsinrichtingen en de hoofdverkeerswegen van de Gare de l'Est te Parijs. (7 700 woorden & fig.)

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VAN STIPRIAAN LUISCIUS (H. A. J.). — Nieuw type motor voor tramwegen, system Sécheron. (1 600 woorden & fig.)

De Locomotief. (Amsterdam.)

1929 621 .137.1
De Locomotief, 10 April, nr 15, p. 118.
Het opstoken van locomotieven. (1 200 woorden & fig.)

1929 656 .1 (.435) & 656 .2 (.435)
De Locomotief, 1 Mei, nr 18, p. 140.
Moet in Sleeswyck de spoorweg door de auto vervangen worden? (2 000 woorden.)

Spoor- en Tramwegen. (Utrecht.)

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Historische aanteekeningen omtrent de Solo-Djokjaverbinding van de Staatspoorwegen. (3 100 woorden & photog.)

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BORNHAUPT (W. K.). — Het magazijn der Staatspoor- en tramwegen in Nederlandsch-Indië te Tjikoedapateuh (Bandoeng). (3 400 woorden & fig.)

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WEISFELT (W.). — Onderdoorgang onder het emplacement Heerlen. (2 200 woorden & fig.)

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Spoor- en tramwegen, nr 9, 30 April, p. 262.
BEELAERTS VAN BLOKLAND (C.). — Het medegebruik van het station Herzogenrath door de S. S. (2 200 woorden & fig.)

1929 621 .132.6 (.492)
Spoor- en Tramwegen, nr 8, 16 April, p. 232.
LABRIJN (P.). — Nieuwe locomotieven voor de Nederlandsche Spoorwegen. (1 500 woorden, tabel & fig.)

In Polish.

Inzynier Kolejowy. (Warszawa.)

1929 **625 .142 (.492)**

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Revista das Estradas de Ferro. (Rio de Janeiro).

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Revista das Estradas de Ferro, n° 87, 28 de Fev., p. 81.

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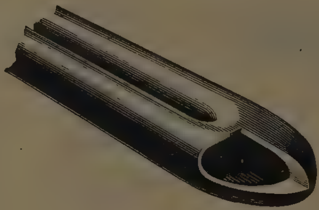

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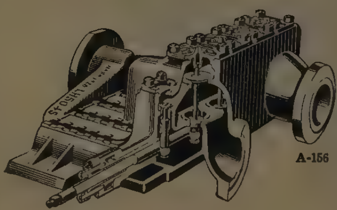

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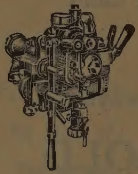

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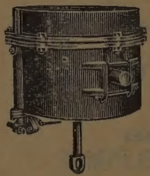

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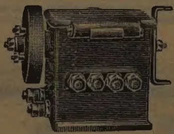

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